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Assembled in the Office of the Director by R. S. Dyal, Special Assistant to the Director.

ERRATUM: Quarterly Progress Report No. 17 should read:

Report for July-September 1958 — Issued October 1958

OUR SOIL ★ OUR STRENGTH

Report for January-March 1959 — Issued April 1959

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Virginia

LIME EFFECT ON BRACKISH WATER IRRIGATION

J. Lunin and M. H. Gallatin, Norfolk.--Irrigation of acid soils with saline waters increases soil acidity and thereby increases the possibility of detrimental effects from excessive soluble iron, aluminum, and manganese. This is of special interest to potato growers who must grow their crops on acid soils.

A greenhouse experiment was conducted to study the effect of brackish water irrigations on beans grown on an acid Sassafras soil having an initial pH of 4.70. One batch of soil was limed at the rate of 1,000 pounds per acre and another batch at the rate of 3,000 pounds per acre. Beans were planted and pots within each pH level received the equivalent of four 1-inch irrigations of 3 dilutions of sea water throughout the growth of the crop. At maturity, both pods and total tops were harvested and the soil and plants analyzed.

The data presented in the table indicate that the primary deterrent to plant growth was salinity. The effect of salinity was much more evident in the yield of bean pods than in the weight of tops. It is also apparent that the relative depression in yield was much greater where no lime was applied than where the soil was limed. Even though there was a big difference in the calcium level of both soils and plants at the three lime levels, it is not likely that calcium was a factor limiting growth. Within each lime level salinity increased soil acidity, the amount of extractable manganese in the soil, and the amount of manganese taken up by the plant. Liming reduced both the extractable manganese in the soil and that taken up by the plant. It is probable that the greater availability of manganese resulting from salinization was responsible for the greater relative reduction in yields due to brackish water irrigation where no lime was added.

Effect of brackish water irrigation on soil and plant composition, Norfolk, Va.

Lime added per acre	E. C.* of water applied	Yield of pods	Dry wt. of tops	pH of soil	EC_e** of soil	Mn in soil	Mn in plant	Exch. Ca in soil	Ca in saturation extract	Ca in plant
Pounds	*mmhos/cm*	*Grams*	*Grams*			*p.p.m.*	*Percent*	*me/100g.*	*me/l*	*me/100 g.*
0	0	32.7	13.6	4.70	0.41	15	0.049	0.83	1.37	42.8
0	2	11.2	12.7	4.48	3.02	18	0.120	0.76	4.60	62.7
0	4	1.9	9.6	4.30	5.69	22	0.141	0.71	9.22	65.1
0	8	0	5.6	4.27	11.45	27	0.138	0.61	17.53	90.3
1,000	0	50.6	16.1	4.98	0.40	10	0.023	1.49	2.39	69.3
1,000	2	33.7	14.4	4.76	2.83	6	0.059	1.29	6.37	106.6
1,000	4	12.6	13.3	4.64	5.67	17	0.095	1.23	13.28	101.9
1,000	8	0	6.7	4.64	11.97	21	0.073	1.17	26.09	135.5
3,000	0	48.8	19.6	5.69	0.48	3	0.017	2.76	3.91	139.1
3,000	2	34.2	16.4	5.51	3.16	6	0.033	2.72	13.36	165.6
3,000	4	20.6	14.1	5.36	5.81	5	0.048	2.49	22.44	171.2
3,000	8	1.0	9.0	5.31	11.97	9	0.066	2.30	41.00	223.1

*Electrical conductivity (1 mmho./cm. is approximately equivalent to 640 p. p. m. of salt.)

**Electrical conductivity of saturation extract.

It is possible that a greater availability of iron and aluminum, as well as manganese, may cause similar results when other acid soils are irrigated with brackish water.

Alabama

WATER-USE EFFICIENCY AFFECTED BY FERTILIZATION

R. D. Doss, Thorsby.--The efficiency with which three summer grasses utilized soil moisture in the production of dry matter in 1957 was influenced by both nitrogen and moisture regimes. Data showing the yield of forage of Coastal Bermuda, Bahia, and Dallas grasses and their water-use efficiency under two soil moisture levels and three rates of nitrogen are given in the table. The dry matter production per inch of water by Coastal Bermuda, Bahia, and Dallas grasses increased with each increment of nitrogen applied. The highest amount of nitrogen applied was at the rate of 600 pounds per acre. Total yield was not increased by irrigation in 1957, therefore, the efficiency of water use was greatest on the unirrigated plots. Water was used most efficiently by Coastal Bermuda grass and least efficiently by Dallas grass.

Yield of forage of Coastal Bermuda, Bahia and Dallas grasses and their water-use efficiency under two soil moisture levels and three rates of nitrogen, Thorsby, Ala. 1957

Moisture level	Nitrogen applied per acre	Grass yield per acre and water-use efficiency					
		Coastal Bermuda		Bahia		Dallas	
		Yield	Water-Use efficiency	Yield	Water-Use efficiency	Yield	Water-Use efficiency
	Pounds	*Pounds*	*	*Pounds*	*	*Pounds*	*
Not Irrigated	0	3,341	196	4,069	239	2,693	158
	150	11,169	655	10,442	612	6,889	404
	600	19,911	1,168	18,127	1,036	12,201	716
Irrigated	0	3,117	114	3,845	141	1,644	60
	150	10,437	383	9,238	339	5,566	204
	600	18,811	690	20,756	762	10,197	374

*Expressed as pounds of dry matter produced per inch of water used.

Texas

EFFICIENT USE OF IRRIGATION WATER REQUIRES OPTIMUM IRRIGATION

Marvin E. Jensen and Willis H. Sletten, Bushland.--Maximum production of hybrid grain sorghum per acre-inch of water (water-use efficiency) was obtained when optimum irrigation and fertilization were maintained. Results of a three-year study indicate that optimum irrigation results in high water-use efficiency in wet or dry years. Water-use efficiencies on low irrigation levels are variable and greatly dependent on distribution of rainfall in relation to crop requirements.

A summary of evapotranspiration and irrigation water applied is shown in table 1.

Average water-use efficiencies based on total annual evapotranspiration are summarized in table 2.

TABLE 1.--Average evapotranspiration and irrigation water applied to hybrid grain sorghum for 1956, 1957, and 1958, Bushland, Tex.

	Moisture treatment					
	M_1	M_2	M_3	M_4	M_5	M_6
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Average annual evapotranspiration........	13.4	17.1	20.0	21.6	23.7	20.3
Average annual irrigation water applied[1]............................	5.8	9.8	13.8	15.2	17.3	13.8

[1] Includes preplanting irrigations.

TABLE 2.--Average production of hybrid grain sorghum per acre-inch of evapotranspiration for 1956, 1957, and 1958, Bushland, Tex.

Average for period.	Fertilizer treatment	Grain sorghum yield per acre						
		Moisture treatment						
		M_1	M_2	M_3	M_4	M_5	M_6	Average
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1956...........	---	60	132	253	298	225	216	197
1957 & 1958....	F_2	231	306	230	210	184	245	234
	F_4	227	311	318	321	291	303	295
	F_5	228	332	307	336	305	318	304
1957-58 average	---	229	316	285	289	260	289	278
3-year average	---	172	255	274	292	248	264	251

L.S.D. (For 1957 and 1958 averages only)

	Percent	Percent
Between moisture means	18.0	23.6
Between fertilizer means	11.2	14.7

Moisture x fertilizer interaction significant at the 1 percent level.

Nitrogen fertilizer was applied in 1956 and 1958 at rates of 0, 120, and 240 pounds of nitrogen per acre on F_2, F_4, and F_5, respectively. Fertilizer was not applied in 1957 because response to nitrogen did not occur in 1956. The experiment was located on Pullman silty clay loam farmed under dryland conditions prior to 1956.

The increase in production over dryland yields per acre-inch of irrigation water applied is shown in table 3.

These data show that maximum grain produced per acre-inch of irrigation water also occurs when optimum irrigation levels are maintained. Nitrogen fertilizer is a requirement on this soil after several years of irrigation for maximum water-use efficiency.

TABLE 3.--Increase in grain sorghum production (RS-610) over dryland yields per acre-inch of irrigation water applied, Bushland, Tex.

Fertilizer treatment	Grain sorghum yield per acre						
	Moisture treatment						
	M_1	M_2	M_3	M_4	M_5	M_6	Average
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
F_2..............	155	293	237	250	183	227	224
F_4..............	152	289	326	356	277	304	284
F_5..............	151	304	304	368	300	323	292
Average.........	153	295	289	325	253	285	267

Other factors such as lodging, low test weights, and variable yields that occurred on low moisture levels must be considered. Economic evaluations must consider the utilization of low-producing wells during winter months over a larger acreage and possibly concentrating these wells on a smaller acreage during summer months for maximum economic returns.

DRAINAGE

Virginia

FORMED LAND REQUIRES ADDITIONAL GRADING AFTER SOIL SETTLES

Phelps Walker and J. H. Lillard, Blacksburg.--Varying degrees of soil compaction caused by land-forming operations in Virginia resulted in uneven land settling after several periods of soil wetting and drying. Therefore, it was necessary to follow the initial grading with additional operations to remove soil compaction and to restore uniform slope to the land. The additional operations were:

1. Scarification by plowing or chiseling to loosen the soil to the depth of the compacted layer.

2. Conditioning by disking to reduce clod size.

3. Smoothing by planing to restore uniformly graded slopes to the land surface.

Time requirements for accomplishing these operations on the surface drainage experimental area in a heavy Virginia Coastal Plain soil amounted to 1.1 hr./ac. for plowing, 0.7 hr./ac. for disking, and 2.3 hr./ac. for planing. The soil remained idle through the wet winter months between the initial forming and these operations. A 3-plow tractor with matching tillage tools and a 30-foot landplane were used. Final forming costs computed at $4.50 per machine-hour for all equipment totaled about $18 per acre.

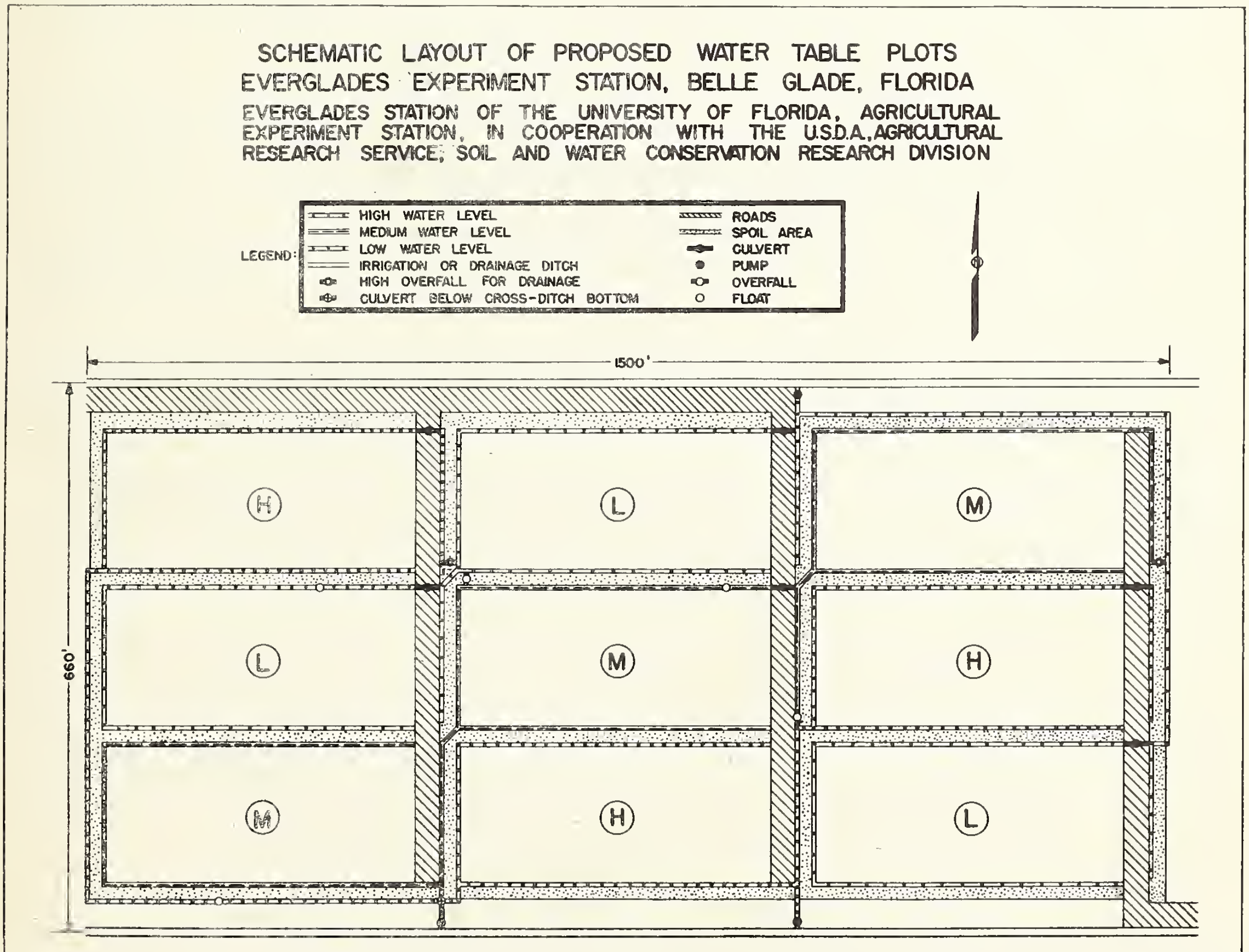
Previously reported initial forming costs, which depend largely on the amount and distance of the material moved, were $62 per acre for grading in both cardinal directions to obtain a smooth plain surface sloping with the natural topography of the land; and $35 per acre where grading was limited to the direction of future crop rows (parallel to permanent ditches) thereby insuring an unbroken slope in row channels (see page 6, Quarterly Report No. 14). Applying the final grading costs to these values resulted in a total land-forming cost of $80 per acre to obtain an inclined surface and $53 per acre to grade only parallel to crop rows. The secondary smoothing might well be a part of the seedbed preparation.

WATER TABLE STUDY INITIATED ON ORGANIC SOIL

H. A. Weaver and W. H. Speir, Ft. Lauderdale, and D. S. Harrison, Belle Glade.-- An investigation to determine the effect of water table level on crop, water, and soil behavior was initiated on a peaty muck soil at Belle Glade during 1958. The experiment will have a five-year duration.

The depths to water table utilized will be 14, 22, and 36 inches. Detailed studies will be made of the effects of water level on crop yield; quality; water requirements; soil subsidence; chemical, physical and biological soil characteristics; and insect, weed, and disease control. The experimental area is comprised of nine 2-acre main blocks arranged in a Latin square with each of the 3 water levels represented 3 times. Constant depths to water table within the main blocks will be maintained by subirrigating from periphery ditches containing water at automatically controlled levels. Various representative vegetable, field, and fiber crops will be used in the study.

The investigation is probably the first long term controlled water table experiment on organic soils under subtropical conditions making use of replicated field plots. It will be directed particularly toward following leads gained from previous investigations with regard to extending information on crop water tolerance levels and soil changes occurring with subsidence.



Nevada

NEVADA SEEPAGE METER SHOWS IMPROVED RESULTS

Victor I. Myers, Lloyd E. Myers, Jr., Reno. --Data obtained from a series of tests of the Nevada seepage meter in 1957 and 1958 has a calculated coefficient of variation of 33.3 percent as compared with 83.3 percent for data obtained with the meter modified to simulate the operation of a standard seepage meter.

The Nevada meter differs from other seepage meters in that it has a conical top that can be separated from the rest of the meter by unscrewing a threaded bolt from a nut attached to the framework. This allows water to escape from the meter as it is placed in a canal or ditch bottom and thus avoids disturbance of the soil. After the meter is placed in position, the conical top is screwed down against a water-tight seal.

A satisfactory system was found for measuring the seepage rate from the meter. It consists of a calibrated glass tube which is placed in the supply line to the meter. The glass tube operates in a horizontal position. An air bubble is injected into a tee passing into the glass tube. The time it takes for the bubble to travel between two calibrated marks gives the instantaneous rate of seepage for the meter.

To evaluate the seepage meter, a system of controlled seepage conditions was set up. A large sheet metal tank seven feet in diameter and five feet high was partially filled with a sandy loam soil. The bottom of the tank was perforated and, underneath, a cone was attached to collect the seepage effluent. At any given moment the rate of seepage from the meter can be compared with the rate of seepage from the tank.

Some tests were performed placing the Nevada seepage meter in the soil with the conical top closed to simulate a standard seepage meter. It was observed that, when the meter was pushed into position in this manner, soil was displaced from around the edge of the meter as water escaped. The measurements of seepage, under these conditions, varied from zero to a rate of 4.00×10^{-3} cubic feet per square foot per minute. This method of placing the meter in the soil results in undue disturbance of the soil surface and accounts for the erratic results. Substantially more accurate measurements of seepage resulted with the elimination of soil disturbance by placing the meter in the soil with the top in an open position.

An evaluation was made in the seepage tank of the desirable depth to which the meter should be placed for best results. Consistent results were not obtained in a sand and a sandy loam until the meter was pushed approximately two inches into the soil. The farther the meter was pushed into the soil beyond two inches, the greater was the departure of the meter seepage rate from that of the seepage tank. The meter discharge at the two-inch depth was 119.7 percent, and that at the four-inch depth, 126.2 percent of the seepage tank discharge rate.

Nevada

IRRIGATION EFFICIENCY TRIALS EXPANDED FOR DRAINAGE STUDIES

Victor I. Myers and Myron B. Rollins, Reno. --Irrigation efficiency trials being conducted on the Newlands Project in Nevada, where serious high water table problems exist, are expected to contribute a fund of information helpful in determining needed and appropriate irrigation and drainage practices for the several soil drainage categories of the project. Soils of the project are arranged into a few broad categories for drainage studies and serve as a basis for all project soil and water investigations.

The usual information obtained from irrigation efficiency trials includes the following: rate of advance, rate of recession, infiltration rate from infiltrometer rings, soil moisture deficiency before irrigation, and irrigation efficiency.

A drainage-irrigation efficiency trial includes the following. Several weeks prior to the irrigation trial, piezometer banks and wells are installed near the top and bottom of the field to be irrigated. Prior to the irrigation trial, a composite soil sample is taken with a king tube to the water table. After irrigation, another composite sample is taken to the same depth. The difference in water content in the two samples includes soil moisture replenishment and deep seepage that has caused the water table to rise.

During the trial and periodically thereafter, enough readings of depth to water table are made in the piezometers to establish the hydrograph of water table rise and recession. Where water table fluctuations are a problem, a knowledge of the shape of the hydrograph is vital in determining the need for drainage and it serves as an excellent selling point for convincing farmers of the need for drainage. Data from the piezometer banks are also useful for determining several facets of the ground water problem.

Soil permeability tests are made following the trial, using the auger hole or some other suitable method. Where stratifications exist in the soil, such tests taken at several depths determine the relative permeability of the various strata.

Other measurements and data are taken in accordance with usual procedures followed in conducting irrigation trials where water tables are not a problem.

Canal and ditch seepage is frequently the cause of water table problems, in addition to being a big water conservation problem. Seepage measurements made in conjunction with drainage-irrigation trials add a valuable fund of information when correlated with drainage categories.

Irrigation-drainage trials can be more useful for technicians and farmers if they include the additional investigations described.

EROSION AND RUNOFF CONTROL

Maine

ROCK REMOVAL STUDY STARTED

E. Epstein and W. J. Grant, Orono.--Runoff plots are being installed to study the effects of rock removal and field crushing without removal on soil erosion, runoff, and other soil physical properties. This study is being conducted on the Caribou loam, a predominant potato soil in Aroostook County with an 8 to 10 percent slope.

Potato harvest occurs in the late fall and, consequently, the soil is left bare throughout the winter months. These soils are stony (40-50 percent material greater than 2 mm.) and, after spring melt, the surface is covered with stones as shown in the accompanying photograph. In previous years, the larger rocks were removed by hand. However, with the advent of the potato harvester, mechanical rock picking has come into use. The mechanical rock picker removes rocks greater than 1-1/4 inches in diameter. Rocks are thought to act as a mulch and aid in reducing the rainfall impact. This study will attempt to provide information on the importance of rocks with respect to runoff and erosion, and to show cultural practices necessary to reduce erosion on such soils. It is also felt that compaction will be more serious when these rocks are removed. One of the studies will involve the returning of rocks in crushed form (less than 1-1/4 inches) to the soil.

Stony surface of Caribou loam after spring melt, Aroostook County, Maine, 1958

New York

INFORMATION ON "AN ALLOWABLE RATE OF SOIL LOSS"

G. R. Free, Ithaca.--The development of soil loss estimating equations or methods such as "slope-practice" now gives the farm planner a tool by which he can combine various erosion control and soil management practices with existing soil, climatic, and topographic conditions to provide field erosion control at a specific level, frequently referred to as an allowable or permissible rate of soil loss. To make full use of the development, however, it is necessary to know what are allowable soil losses in terms of tons per acre per year. Quantitative data from which to derive allowable losses for different soils are scant.

Some insight on allowable losses from three New York soils are given in the accompanying table. Plots used in the study had been subjected to various cultural and management treatments over a period of years which resulted in the average annual erosion losses reported. Then, all plots were placed under uniformly good soil management for a period of years which included good rotations and adequate fertilization. Crop yields were followed in order to measure the rate of recovery from the loss in productivity resulting from the earlier erosion losses. Yield data given in the table are for corn taken at a base of 100 for the plots having the lowest previous annual soil loss.

Although marked recoveries of productivity have resulted, most of the plots did not recover completely when earlier soil losses were appreciable. On the Bath flaggy silt loam, for example, complete recovery was obtained after 9 years where the earlier annual soil losses were only 1.3 tons per acre, however, only 92 and 87 percent recovery was obtained for annual losses of 2.6 and 6.7 tons per acre, respectively.

Recovery patterns for the Bath and Ontario soils were not continued beyond the years shown. Additional years of data for the erosion plots on Honeoye soil indicate only an asymptotic approach to recovery in 16 years of good management. Data from plots of another experiment on Honeoye soil where effects of continuing differential erosion are under study suggest that erosion rate of 12 tons per acre per year (determined from measurements of deposits below plots) is not low enough to prevent a decreasing trend of productivity with time.

Effects of measured past erosion on subsequent corn yields, Ithaca, N. Y.

Soil	Average annual erosion losses per acre over years shown	Relative corn yields[1] under good management following differential erosion shown at left	
		For first year	For year shown
	Tons		
Bath flaggy silt loam (erosion on this soil very selective). Only 29 percent of plow layer < 2mm. compared to 95 percent of soil washed off.	0.1 (1935-45) 1.3 (1935-45) 2.6 (1935-45) 6.7 (1935-45)	100 62 52 35	100 (ninth) 101 (ninth) 92 (ninth) 87 (ninth)
Ontario sandy clay loam (erosion on this soil not particularly selective).	0.7 (1936-46) 11.0 (1936-46) 18.1 (1936-46)	100 75 64	100 (seventh) 71 (seventh) 81 (seventh)
Honeoye silt loam (erosion on this soil intermediate in selectivity).	0.4 (1939-42) 67.5 (1939-42)	100 47	100 (sixth) 85

[1] Base yields (100 percent) on all soils for years when corn was grown during recovery period ranged from 62 to 105 bushels per acre.

These data bearing on the question of what constitutes "an allowable soil loss" were obtained as "by-products" from experiments originally established with other objectives in mind. A need for more data in the lower range of losses is indicated, particularly for the Ontario, Honeoye, and other key soils.

An allowable soil loss should be set up at something more than zero--since it has not been possible to stop erosion, but only to control it. Erosion will continue to occur at a geologic rate, and there will also be an additional hazard of accelerated erosion accompanying the use of soil when that use involves complete or even partial exposure. An allowable soil loss may differ for different soils depending upon what is present as a starting inventory.

An allowable soil loss should be economically attainable and consistent with efficient and productive use of the soil over a long period of time. For example, an allowable soil loss could be set at not less than the rate at which it is estimated that soil (surface and favorable subsoil) is being formed from parent materials. Certainly it should be low enough so that control measures such as diversions and terraces are not subjected to excessive silting. The waste associated with erosion should be held to limits where losses of fertility (both natural and applied) are not excessive, and where physical deterioration of soil is not excessive either in terms of loss of depth for rooting and for storage of moisture available to crop, or in terms of what constitutes good soil structure. Maintenance of good structure is often a problem even without erosion. The guide to what constitutes excessive loss and deterioration lies in its effects on productivity.

Maryland

STRONTIUM-90 MOVES IN SURFACE RUNOFF

R. G. Menzel, Beltsville.--A small fraction of the strontium-90 fallout on runoff plots appeared in the runoff water from those plots, although the concentration of strontium-90 in the suspended soil of the runoff was 10 times as high as that in the plow layer.

The amounts of strontium-90, originating from nuclear weapons tests, were measured at Tifton, Georgia, and LaCrosse, Wisconsin, in 1957. The results (tables 1 and 2) are expressed in terms of radioactive disintegrations per minute (dpm). The amounts are well below the established permissible level, and were measured merely to investigate the behavior of strontium-90 in the field.

The percentage of fallout in the runoff for individual runoff periods was about the same at both locations, even though soil conditions and rate of fallout were quite different. On the plots with good cover and low soil loss, the oats at Tifton and the clover at LaCrosse, less than one percent of the fallout appeared in any runoff. On the other plots, up to five percent of the fallout appeared in the runoff, except for one large runoff at LaCrosse in which thirty percent appeared. The soil type at Tifton is Tifton loamy sand with three-percent slope. That at LaCrosse is Fayette silt loam with sixteen-percent slope. Rate of fallout of strontium-90 was almost twice as great at LaCrosse as at Tifton. The rainfall in both locations was several inches above average and well distributed throughout the period of observation.

The concentration of strontium-90 in the runoff, based on amount of solid material in the runoff (table 3) was about 10 times as high as the average concentration in the plow layer. Where runoff sediment accumulates in bottom land fields, the amount of strontium-90 will be higher than in the upland fields.

TABLE 1.--Strontium-90 in fallout and runoff from corn, oats, and peanuts plots at Tifton, Georgia, 1957

Runoff period	Strontium-90			
	Fallout	Corn plot runoff	Oats plot runoff	Peanuts plot runoff
	dpm/ft^2	*dpm/ft*^{2}	*dpm/ft*^{2}	*dpm/ft*^{2}
3/11 - 3/25..........	21	0.2	0.2	0.5
3/25 - 4/6...........	26	1.5	0.1	1.0
4/6 - 6/4...........	58	0.6	0.3	0.8
6/4 - 7/1...........	57	0.2	0.4	0.3
7/1 - 7/8...........	63	1.5	0.5	1.2
7/8 - 7/28..........	56	0.2	0.1	0.3
7/28 - 8/20..........	23	0.3	0.1	0.3
Total.................	304	4.5	1.7	4.4
Total strontium-90 in soil March 11, 1957		1,120	980	1,410

TABLE 2.--Strontium-90 in fallout and runoff from corn, oats, and clover plots at LaCrosse, Wisconsin, 1957

Runoff period	Strontium-90			
	Fallout	Corn plot runoff	Oats plot runoff	Clover plot runoff
	dpm/ft²	*dpm/ft²*	*dpm/ft²*	*dpm/ft²*
3/13 - 5/14.........	179	2.4	1.7	No runoff
5/14 - 5/25.........	85	1.7	1.3	No runoff
5/25 - 6/5..........	65	18.6	18.2	0.8
6/5 - 6/16.........	27	0.4	0.4	0.1
6/16 - 7/3..........	43	0.2	0.6	0.4
7/3 - 7/16.........	50	0.3	0.4	0.2
7/16 - 7/21.........	25	0.8	0.3	0.2
7/21 - 8/18.........	83	0.5	No runoff	No runoff
Total...............	557	24.9	22.9	1.7
Total strontium-90 in soil April 11, 1957		1,280	1,980	1,670

TABLE 3.--Concentration of strontium-90 in soil from plow layer and in runoff, LaCrosse, Wis., Tifton, Ga., 1957

Location and sample	Concentration of strontium-90		
	Corn plot	Oats plot	Clover plot
LaCrosse, Wisconsin:	*dpm/ft²*	*dpm/ft²*	*dpm/ft²*
Soil from plow layer.......	0.09	0.10	0.10
Runoff, 3/13 - 8/18........	1.07	0.90	2.91
Tifton, Georgia:	Corn plot	Oats plot	Peanuts plot
Soil from plow layer.......	0.03	0.04	0.04
Runoff, 3/11 - 8/20........	0.36	0.28	0.30

South Carolina

RUNOFF AND EROSION HIGHEST DURING SOD ESTABLISHMENT

O. W. Beale, Clemson. --Runoff and erosion were relatively high during establishment of fescue-clover and Coastal Bermuda grass pastures, but measurements made over periods of five to seven years however, showed considerable reduction in soil loss after sod establishment. Runoff was reduced to a lesser extent. Subsoiling a fescue-clover pasture apparently caused sizeable decreases in runoff and erosion the first year, but the effect was much less the second year.

Plots, 1/30 acre in size, were installed in pastures of fescue-clover and Coastal Bermuda grass at planting. Treatments included normal tillage and subsoiling for the fescue-clover, and normal tillage only for the Coastal Bermuda grass pastures. Runoff and erosion during two years of establishment on these pastures are shown in table 1. Soil loss from the Coastal Bermuda grass pasture during the first year was about 5 tons and the second year about 0.1 ton per acre, with no substantial change in runoff.

Table 2 shows averages of annual data for the entire period of measurements. Data for fescue-clover on 9 percent slopes are averages of measurements for 2 pastures well established before plots were installed. Nitrate nitrogen, phosphate, and potash losses in runoff are also given. After sods were established, soil losses were negligible, but runoff was fairly high. Runoff from some rains of several hours duration was as high as 50 percent of rainfall. The high soil losses for the fescue-clover on 19 percent slope were due to excessive losses during establishment. Nutrient losses in runoff were not high. However, more potash was lost than nitrogen or phosphate.

TABLE 1.--Runoff and erosion during establishment of pastures, South Carolina

Pastures	Slope	Rainfall		Runoff		Erosion	
		1st yr.	2nd yr.	1st yr.	2nd yr.	1st yr.	2nd yr.
	Percent	*Inches*	*Inches*	*Inches*	*Inches*	*Tons/Acre*	*Tons/Acre*
Fescue-clover, subsoiled.	19	48.1	37.7	11.0	9.1	6.7	2.1
Fescue-clover, not subsoiled..................	19	48.1	37.7	16.8	8.9	14.2	2.9
Coastal Bermuda grass, not subsoiled..........	14	45.2	51.2	1.7	2.8	5.2	0.1

TABLE 2.--Average annual runoff, erosion and plant nutrient losses from grazed pastures, South Carolina

Pastures	Slope	Rainfall	Runoff	Erosion	N	P_2O_5	K_2O
	Percent	*Inches*	*Inches*	*Tons/Acre*	*Lbs/A*	*Lbs/A*	*Lbs/A*
Fescue-clover................	9	47.3	5.1	0.1	0.3	2.7	6.6
Fescue-clover, subsoiled.....	19	46.5	7.7	1.9	0.4	2.5	6.5
Fescue-clover, not subsoiled.	19	46.5	9.6	3.5	0.5	2.0	8.1

Note: Fescue-clover on 9 percent slope measured 7 years and on 19 percent slope 5 years. Data are averages of all years.

Texas

EVAPORATION CONTROL TREATMENTS AFFECT RUNOFF AND EROSION

J. E. Adams and D. O. Thompson, Temple.--Bare plots with 1/3 and 2/3 of the soil surface treated with 0.1 percent dimethyldioctadecylammonium chloride $[(CH_3)_2(C_{18}H_{37})_2NCl]$ to a depth of 1 inch had more runoff and erosion in 1958 than bare untreated soil. Other plots with the same chemical treatment but with a pea gravel mulch 2 inches thick had no runoff.

The evaporation control treatments shown in the table were applied to eight 1/100 acre (6 x 72.6 feet) runoff control plots on Austin clay at Temple in March 1958. Plots had 1/3 of the surface area treated with $(CH_3)_2(C_{18}H_{37})_2NCl$ in strips 1 foot wide

alternating with 2-foot untreated strips. Plots with 2/3 of the surface area treated with this compound had treated strips 2 feet wide alternating with 1-foot untreated strips.

Dr. R. J. Hanks (ARS) found that a one-inch depth of soil treated with 0.1 percent $(CH_3)_2(C_{18}H_{37})_2NCl$ effectively reduced evaporation in laboratory studies at Kansas State College (1956 ARS Annual Report of Research, Manhattan, Kansas). More recent data from the same location indicates marked infiltration reduction also due to this chemical treatment.

Results from April 1 - December 28, 1958 are shown in the accompanying table. During this period, there was a total of 23.53 inches of rainfall. Of this amount, there were 17 rains which produced runoff and erosion from the 2 bare, $(CH_3)_2(C_{18}H_{37})_2NCl$ treated plots and 10 runoff producing rains on the bare fallow plot. A small amount of runoff was produced from the 1-inch and 2-inch gravel mulch and the 2-inch straw mulch plots after nearly 7 inches of rain in April and May. No runoff was produced on the 2 chemically treated plots having a 2-inch gravel mulch.

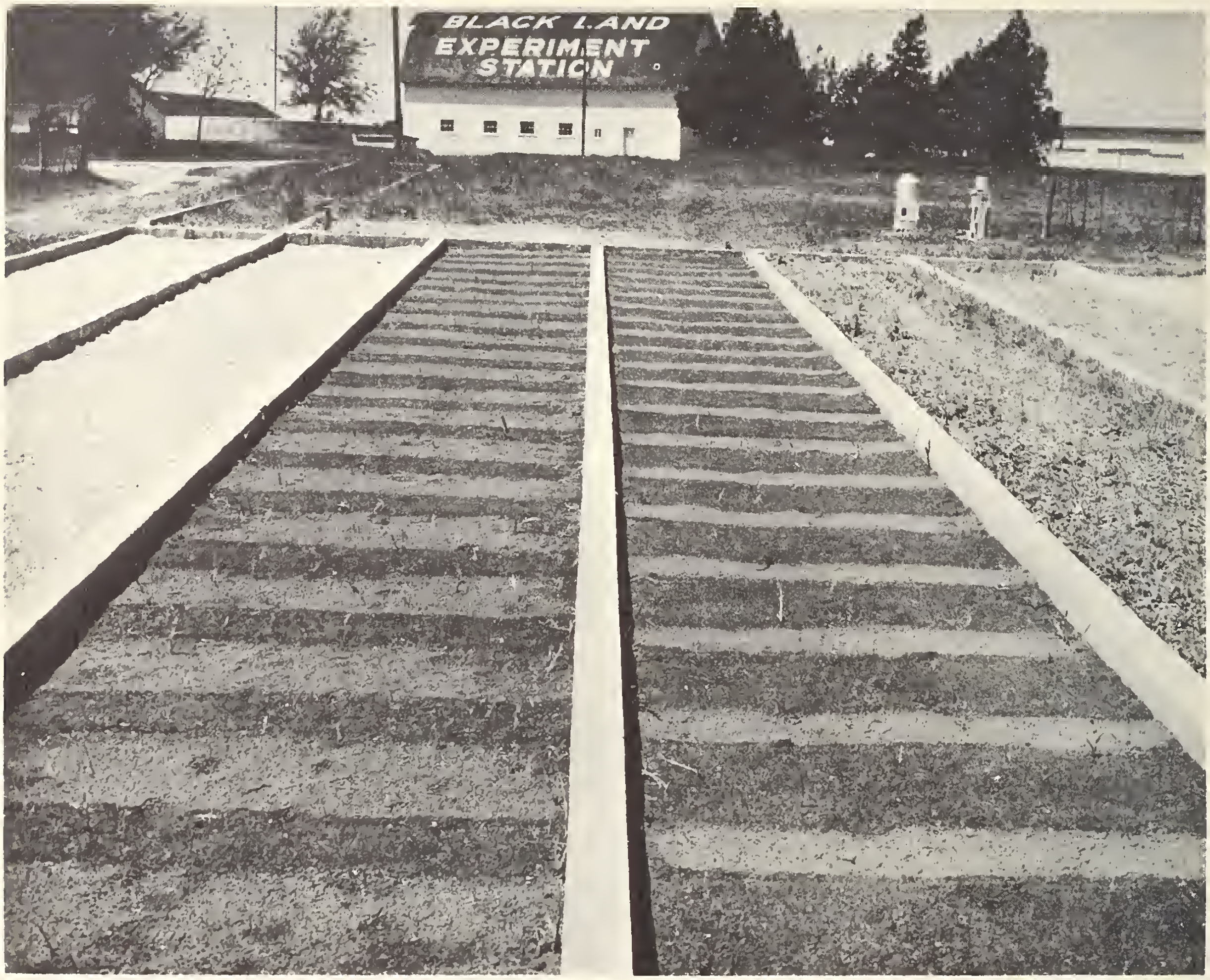
Compared to the bare fallow plot, the plot with 1/3 of the surface treated with $(CH_3)_2(C_{18}H_{37})_2NCl$ had about 1.5 times as much runoff and 7 times as much soil loss, and the plot with 2/3 of the surface chemically treated had nearly twice as much runoff and 5 times as much soil loss. An increase in runoff with an increase in surface area treated was expected, since $(CH_3)_2(C_{18}H_{37})_2NCl$ reduced the capillary conductivity of the soil. The lower soil loss per inch runoff from the plot with 2/3 of the surface treated as compared to the plot with 1/3 of the surface treated may reflect the aggregate stabilizing effect of the chemical.

There was some wetting of the $(CH_3)_2(C_{18}H_{37})_2NCl$ treated soil, as it was dark and wet after a rain and small cracks developed on drying. The amount of wetting probably was small, since the treated soil dried much quicker than untreated soil and shortly after a rain the treated plots shown in the accompanying figure had a banded appearance due to the different degree of drying of the treated and untreated soil.

More measurements and data are necessary before definite conclusions can be drawn regarding the effectiveness of these treatments in controlling evaporation. The 1958 results show that evaporation control treatments may have a considerable effect on runoff and erosion which will require proper evaluation in future studies as well as in practical use.

Effect of several evaporation control treatments on soil and water loss from 1/100 acre runoff plots, Temple, Texas, April 1 - December 28, 1958

Evaporation control treatment	Runoff	Soil loss per acre	Soil loss per inch runoff
	Inches	*Tons*	*Tons*
Bare fallow	3.18	2.07	0.65
1/3 of surface soil treated with 0.1% $(CH_3)_2(C_{18}H_{37})_2NCl$ + 2 inches pea gravel mulch.	0	0	---
2/3 of surface soil treated with 0.1% $(CH_3)_2(C_{18}H_{37})_2NCl$ + 2 inches pea gravel mulch.	0	0	---
Bare - 2/3 of surface soil treated with 0.1% $(CH_3)_2(C_{18}H_{37})_2NCl$.	6.09	10.47	1.72
Bare - 1/3 of surface soil treated with 0.1% $(CH_3)_2(C_{18}H_{37})_2NCl$.	4.93	14.63	2.97
Straw mulch 2 inches thick	0.02	trace	---
Pea gravel mulch 1 inch thick	0.35	0.02	0.06
Pea gravel mulch 2 inches thick	0.27	0.02	0.07



Banded appearance of bare plots treated with 0.1% $(CH_3)_2(C_{18}H_{37})_2NCl$ after 0.50-inch rain the night before. Bare plot on left has treated strips 2 feet wide alternating with untreated strips of soil 1 foot wide. Bare plot on right has treated strips 1 foot wide alternating with 2-foot untreated strips. Photo taken about noon April 9, 1958, Temple, Texas.

Indiana

EROSION FROM CORN AFTER MEADOW DEPENDS ON QUALITY OF MEADOW

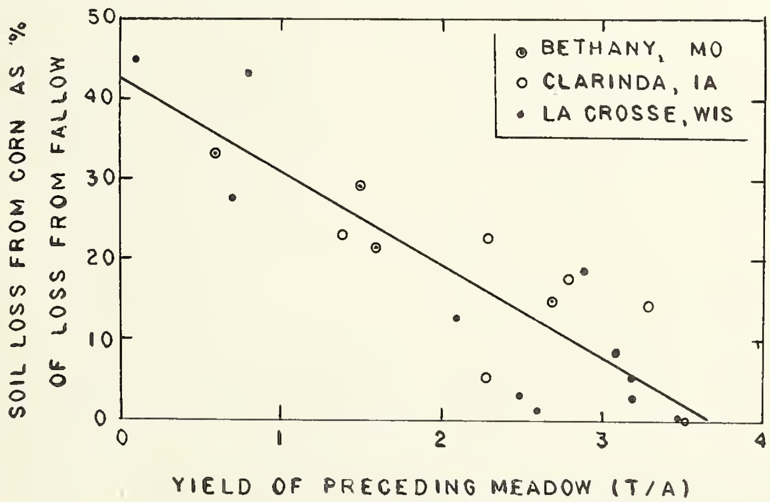
W. H. Wischmeier, Lafayette.--The rate of erosion from corn in a corn-small grain-mixed meadow rotation depends on the quality of the meadow sod turned under. Data from several midwestern soils indicate that corn following a 1-ton annual meadow yield averages from 50 percent to 75 percent more soil loss from large storms within 2 months after planting than does corn following a 2-ton meadow yield under otherwise identical conditions, and from 3 to 4 times as much as corn following a 3-ton meadow yield.

A study of meadow yield as a measure of the soil conditioning effect of grass or grass-and-legume sod turned under before corn was based on measured soil losses occurring within 2 months after corn planting, on plots in corn-small grain-meadow rotation with no fertilizer application to the corn and with meadow harvested for hay. Measured losses from the corn were expressed as percentages of the losses that would have occurred from continuous fallow under the same rainfall and under otherwise identical plot conditions. Since the losses for continuous fallow were computed on the basis of the

specific rainstorms, soil type, and slope involved on each of the respective corn plots, the percentage data plotted in the accompanying figure are directly comparable.

The regression line is based on data for all storms with an erosion index of 20 or greater in 26 plot-years of record on Marshall, Shelby, and Fayette soils. Differences in meadow yields explain 76 percent of the total variance in ratios of soil loss from corn to computed loss from fallow. Some of the remaining variance is accounted for by differences in late summer rainfall on the meadows.

Results of the study suggest the value of further investigation of crop yields as an aid to soil-loss estimation for specific farm fields.



Relationship between yield of preceding meadow and erosion from corn, Lafayette, Ind.

Indiana

SHREDDED STALKS SAVE SOIL

L. D. Meyer and J. V. Mannering, Lafayette. --The practice of shredding cornstalks in the fall appreciably reduces soil loss according to tests during the fall of 1958 with the rainfall simulator. Three common practices of cornstalk residue management were studied: (1) check (stalks as left by cornpicker); (2) stalks shredded only; (3) stalks shredded and disked. Data obtained are shown on the following page.

Both treatments showed a significant decrease in soil loss compared to the check treatment. The check and shredded-only plots produced approximately equal amounts of runoff. However, when the shredded stalks were also disked, the infiltration rate was increased and runoff was decreased. Soil loss was greater from the shredded and disked plots than from shredded-only, due to a much higher concentration of soil in the runoff. From this, disking of shredded stalks appears unnecessary and undesirable unless an extreme problem of blowing exists or soil moisture is badly deficient.

It is important to recognize (1) that shredding is of a major value to only that part of the crop year between cornpicking and seedbed preparation and (2) that stalks must be shredded as soon as possible following picking for maximum benefit.

Runoff, soil loss, and end infiltration rates as influenced by cornstalk residue management, Lafayette, Ind. Sept.-Oct. 1958. Plot slope: 4 to 4-1/2 percent. Simulated rainfall intensity: 2.3 inches per hour.

Measurement	Run	Treatment			Water applied
		Check	Shred	Shred & Disk	
		Inches	*Inches*	*Inches*	*Inches*
Runoff........................	Dry	1.36	1.23	0.63	2.30
	Wet	1.30	1.22	0.89	1.84
		Tons	*Tons*	*Tons*	
Soil loss per acre*.............	Dry	1.35	0.59	0.66	
	Wet	1.12	0.39	0.68	
		Inches	*Inches*	*Inches*	
Infiltration per hour**.........	Dry	0.78	0.77	1.38	
	Wet	0.52	0.57	0.90	

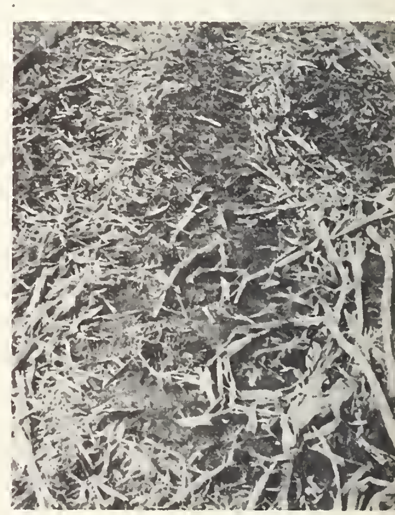
*Adjusted to slope length of 150 feet.
**Determined near end of run when runoff was essentially constant.

The plots of one replication are shown in the accompanying figures. Plot conditions were: soil - Warsaw loam; slope - 4 to 4 1/2 percent; plot size - 35 feet long by 10 feet wide; rows - up and down slope; corn yield - 125 bushels; last cultivation - June 1; replications 2. The two-row rotary shredder which was used failed to shred many of the stalks. It also windrowed the shredded material at one side of the shredder, leaving the other between-row area with relatively poor cover. A better job of shredding should give even greater differences in soil loss between shredded and unshredded treatments than those shown in the table. A "dry" run of 60 minutes duration at the existing moisture condition and a "wet" run of 48 minutes duration the following day at an intensity of 2.3 inches per hour were applied to each plot.

This study will be repeated in 1959 on another soil type with a shredder which shreds the cornstalks more thoroughly and distributes the shredded material more evenly.

Check

Shredded cornstalks



Cornstalks shredded and disked

Plot surface condition following dry and wet runs with rainfall simulator, Lafayette, Ind.

INFILTRATION RATES ON MARSHALL SILT LOAM MEASURED

W. E. Larson, Ames.--Final infiltration rates varied from 0.60 to 0.10 inch per hour on Marshall silt loam using hydrograph analysis of runoff and rainfall records from small plots. The average final infiltration rate was 0.21 inch per hour and the average initial rate was 0.79 inch per hour. Both initial and final infiltration rates varied with the 10 storms and 3 slope lengths studied. The average infiltration rate curve calculated from the mean of all curves for all storms and slope lengths is given in figure 1. The plots were cropped to continuous corn.

Final infiltration rate as influenced by season of the year is given in figure 2. Final infiltration rate appears to increase up to June and July and then decrease rather sharply during August and September. These data should be helpful in predicting rates and amounts of runoff on Marshall and similar soils.

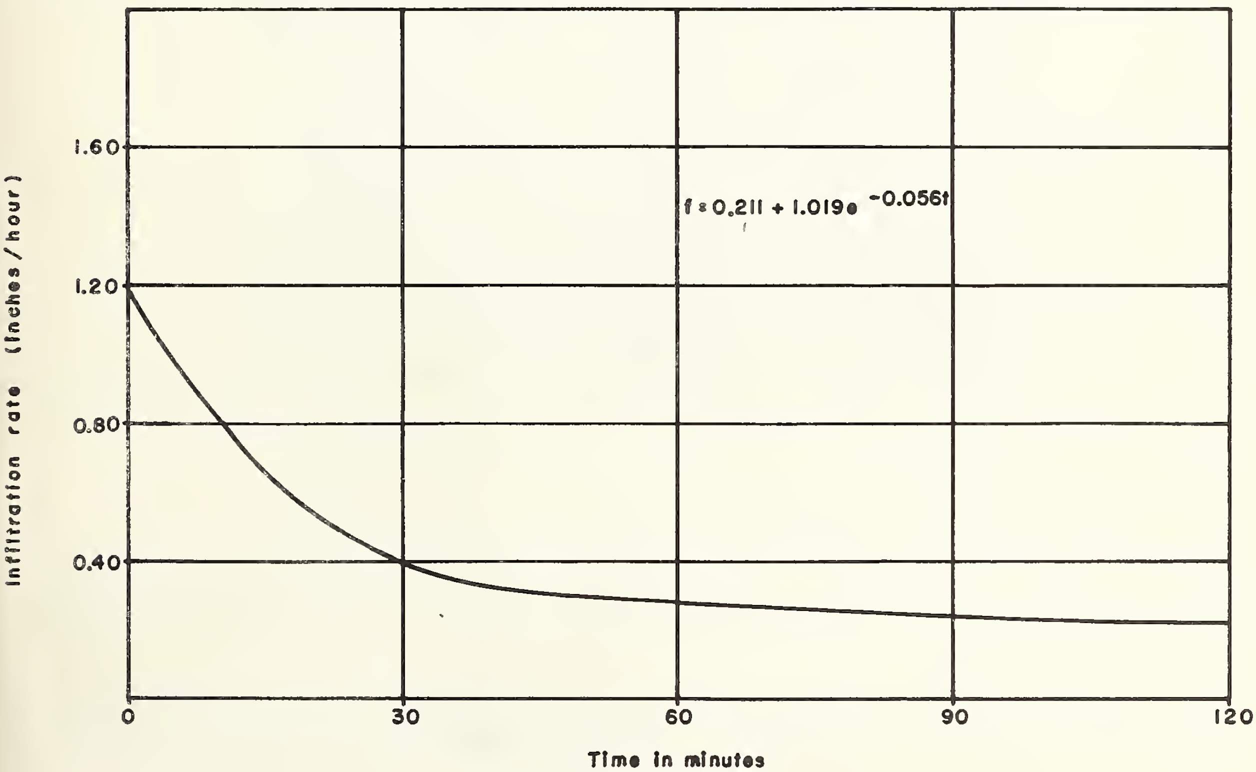


Figure 1. Average infiltration rate curve on Marshall silt loam for 3 slope length plots during 10 storms.

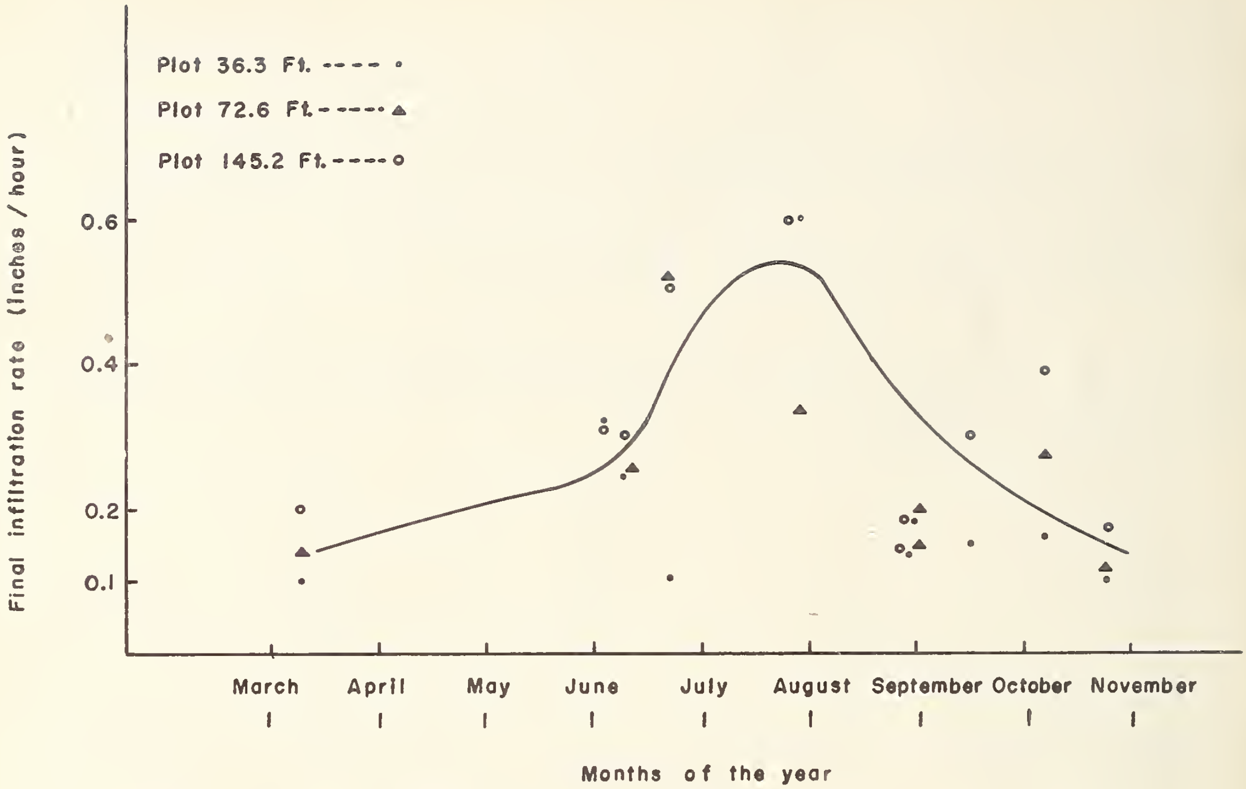


Figure 2. Final infiltration rate on Marshall silt loam as influenced by season of year.

Nebraska

TALL FESCUE THRIVES ON WET WATERWAY

Norris P. Swanson and Ervin O. Peterson (Management Agronomist, SCS), Lincoln. --Tall fescue has shown strikingly greater vigor in 1958 than other grasses grown under wet soil conditions on two experimental waterways near Red Cloud, in south-central Nebraska.

A mixture containing brome, tall fescue, reed canary, and switch grass was planted on one waterway. Replicated plantings were made on the other waterway using brome, brome and western wheat, brome and tall wheat, brome and switch grass, brome and reed canary, and the mixture containing brome, tall fescue, reed canary, and switch grass. The grasses were established in 1956.

The soil ranged from a Nuckolls silty clay loam on the upper portion of the waterways to a Nuckolls silt loam on the lower portion. The soil has good internal drainage and grass roots were found in all soil depths in sampling to 48 inches in late July.

The waterways were wetted by small streams of water simulating irrigation waste water discharge. These streams ran almost continuously from early June through early September 1958, except for short periods of 1 to 3 days, for a total of only 18 days without discharge during the period. The waterways were similarly wetted for 33 days of a 75-day period in the summer of 1957. Spring grazing and 7 mowings from late May through early September added to the severe treatment provided by the prolonged wetting in 1958. Tests with large flow discharges in 1957 and 1958, which did not result in serious damage, show that it is practical and feasible to utilize a vegetated channel to discharge both trickle and high runoff flows.

The more vigorous growth of the fescue has been apparent wherever the mixture was planted. The accompanying photograph of one of the replicated plantings containing tall fescue was typical of this waterway in October 1958. Brome and reed canary were established in the plot immediately above, and brome alone in the plot below, in this photograph. The top growth of the brome on the bottom of the waterway died in late summer, and new growth was starting from the crowns when the photograph was taken. Reed canary and switch grass plants were present but did not show the aggressiveness of the tall fescue.

The presence of tall fescue makes the difference in the denser plot of grass across this waterway. A mixture of brome, tall fescue, reed canary, and switch grass was seeded on this plot. The plot in the immediate foreground was seeded to brome grass, and the adjacent uphill plot to brome and reed canary grass. Experimental waterway, Red Cloud, Nebraska, October 17, 1958.

Colorado

STRIPCROPPING PATTERNS UNDER STUDY

B. W. Greb and A. L. Black, Akron. --Stripcropping has been used in the past primarily on the coarser-textured soils in the Central Plains. Most of the finer-textured level uplands have been bulk farmed to winter wheat. During prolonged drought periods, extensive soil exposure to wind damage has been the result. The advent of better adapted grain sorghums now makes possible better conservation and utilization of total precipitation and reduced wind damage by a feasible fallow-wheat-sorghum combination in strips.

Pilot studies on four stripcropping patterns of narrow dimensions were initiated in 1958 at the Akron Station. The objectives of the patterns include examination of difficulties of farming narrow strips from the standpoint of weed growth, moisture competition and insect damage along strip edges, examination of exposure damage by wind and hail, and the adjustment of strips in such a manner as to take the greatest advantage of snow deposition for sorghum or wheat production. The strip patterns described below are narrower than an operator might consider in bulk plantings, but were arranged to obtain the maximum replication and ratio of widths for the size field available for study.

Pattern No. 1	Straight rotation
Winter wheat	48 ft.
Sorghum	48 ft.
Fallow	48 ft.

**Pattern No. 4	Snow spreading for wheat
Wheat	24 ft.
Sorghum	2 rows 14 in. apart

Patterns No. 2 and 3	Snow trapping for sorghum
Wheat	48 ft.
*Sorghum	12 ft. = 4 rows-continuous
Fallow	48 ft.
*Sorghum	12 ft. = 4 rows-continuous
Wheat	24 ft.
*Sorghum	12 ft. = 4 rows-continuous
Fallow	24 ft.
*Sorghum	12 ft. = 4 rows-continuous

*Sorghum will be grown continuously on moisture trapped from snow blowing off newly planted wheat on fallow. Wheat will alternate with fallow.

**Pattern No. 4 will change location to new fallow each year.

Snow and wind storms during the fall and early winter of 1958 have indicated that the strips of continuous sorghum in patterns No. 2 and 3 where ratios are 4:1 and 2:1 will have to be changed to 8 rows wide to trap snow effectively and prevent overdrifting. The width of wheat strips will have to be changed accordingly.

SOIL FERTILITY

Pennsylvania

RESPONSE TO PHOSPHATE DEPENDS ON RATE AND PLACEMENT

C. L. Rhykerd and C. F. Gross, University Park.--Greenhouse studies, show that the response of red clover seedlings to phosphorus fertilization depends on the rate and placement of the fertilizer as well as the soil type. Morrison loam and Red Bay fine sandy loam were fertilized with various rates of monocalcium phosphate up to an equivalent of 800 pounds of P_2O_5 per acre. Both soils were originally very deficient in phosphorus.

The data in the table show that for both soils the yields of red clover increased with increasing rates of P_2O_5 mixed with the soil up to and including the 800-pounds-per-acre rate. However, the increase in yield obtained by applying more than 400 pounds per acre of P_2O_5 was very small.

Small amounts of P_2O_5 in a band directly below the seed were highly effective in stimulating early growth of the red clover seedlings. For example, on the Morrison soil, yields of clover seedlings with 25 to 50 pounds of P_2O_5 in a band were 4 to 5 times higher than where the same amounts of phosphate were mixed with the soil. Yields from 25 pounds of P_2O_5 banded were higher than from 100 pounds of P_2O_5 mixed with the soil. With very high rates of P_2O_5, there was no advantage from banding the phosphate; in fact, the yields were a little lower from bandings than from mixing the phosphate with the soil.

The advantages of band applications of phosphate were even greater on the Red Bay soil than on the Morrison. Yields of clover were almost as high from 25 pounds of P_2O_5 banded as from 200 pounds mixed with the soil.

Greenhouse studies of response of red clover to rate and placement of phosphorus on Morrison loam and Red Bay fine sandy loam, University Park, Pa.

P_2O_5 per acre	Dry weight of top growth per pot			
	Morrison loam		Red Bay fine sandy loam	
	P_2O_5 mixed with soil	P_2O_5 banded in soil	P_2O_5 mixed with soil	P_2O_5 banded in soil
Pounds	*Grams*	*Grams*	*Grams*	*Grams*
0	0.11	0.11	0.06	0.06
25	0.21	0.94	0.14	0.93
50	0.37	1.91	0.24	1.32
100	0.79	2.37	0.41	1.72
200	2.09	2.58	1.11	2.33
400	3.20	3.02	1.56	2.10
800	3.56	3.22	1.79	2.05

Georgia

SPANISH PEANUT YIELDS HIGHER WHERE ROTATED

A. W. White, Jr., G. N. Sparrow, and R. L. Carter, Tifton.--Over a period of four years yields of Spanish peanuts were highest where the crop was included in a rotation. The data given in the table show that the yield of peanuts when grown continuously decreased considerably over the same period.

All peanut crops received 400 pounds per acre of 5-10-15 fertilizer at planting. The fertilization of crops prior to peanuts in the 2 systems involving rotations may have been a contributing factor to the difference in peanut yields. However, it is believed that the primary reason for the yield difference was a result of the effects of the rotation rather than fertilization of the preceding crop. It has been noticeable during the last few years that the leafspot disease common to peanuts has been more damaging to the crop grown continuously than to the peanut crops grown in either 3- or 4-year rotations.

Spanish peanut yields as affected by cropping system Tifton, Georgia, 1955-58

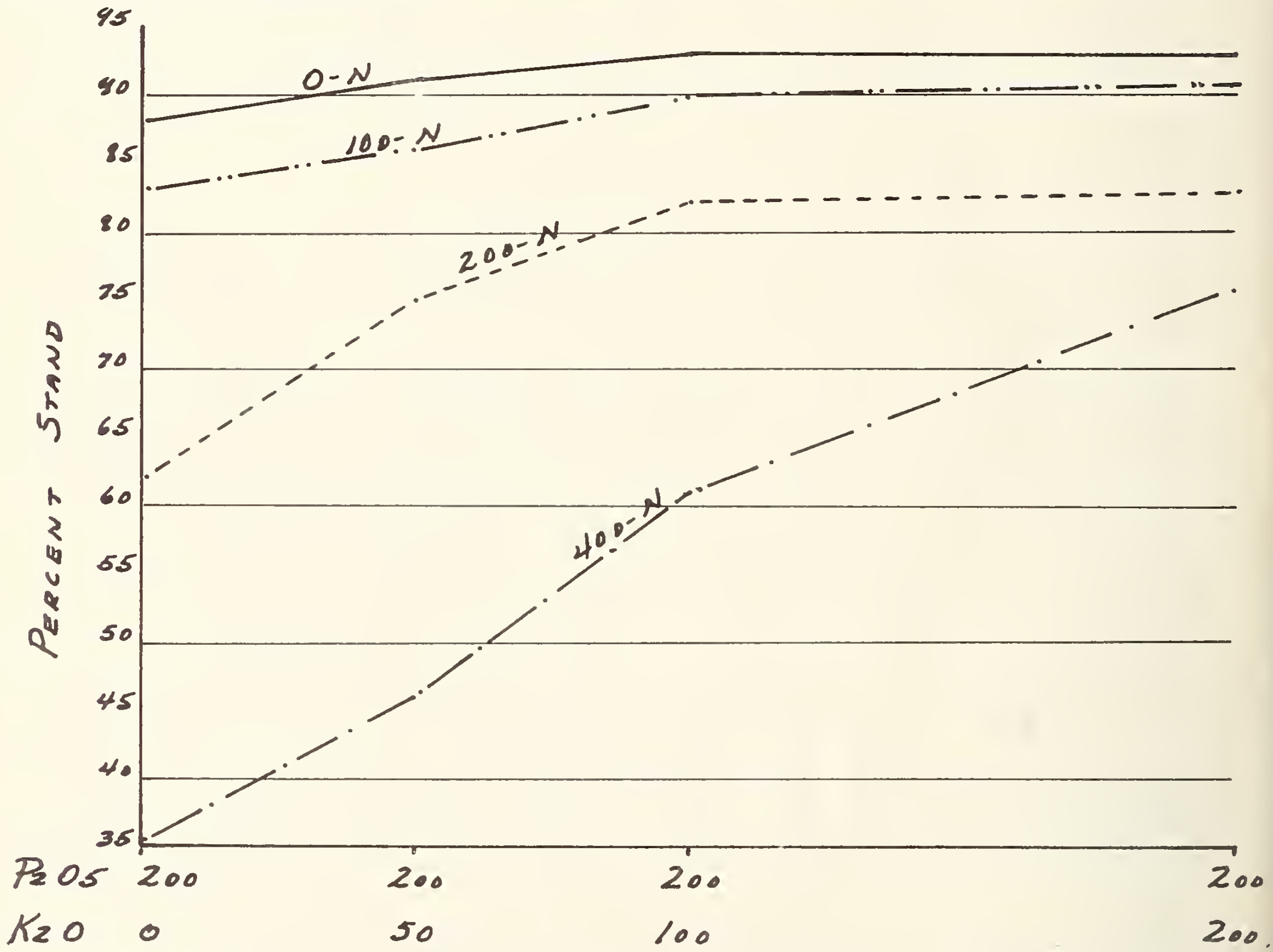
Cropping system	Spanish peanut yield per acre				
	1955	1956	1957	1958	Average
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Continuous peanuts.............	2,070	1,680	1,159	1,183	1,523
Peanuts, corn, oats[1]...........	1,900	1,936	1,780	1,671	1,822
2 years of grass sod, corn, peanuts[2].	2,680	1,811	1,783	1,713	1,997

[1] Peanuts preceeded by winter cover of rye. Corn preceeded by winter cover of Blue lupine.
[2] System includes Crimson clover with sod during winter months.

BALANCED FERTILIZATION REDUCED WINTER INJURY TO GRASS

William E. Adams, Watkinsville. --Cold injury to Coastal Bermuda grass during the rigorous winter of 1957-1958 ranged from severe on plots receiving a combination of low potassium and high nitrogen to negligible on adequately fertilized plots. Phosphorus fertilization did not appear to influence winter killing. Injury to Coastal Bermuda grass stands at 64 levels of soil fertility was rated on June 9, 1958. Cold injury increased as nitrogen fertilization increased, but where potassium was adequate, even at the 400-N level, the survival of Coastal Bermuda grass was satisfactory, see figure.

Yields of Coastal Bermuda grass clipped on June 24, 1958, correlated very closely with the visual stand estimates. These data, together with visual observations, indicate that survival of Coastal Bermudagrass was satisfactory where potassium was adequate, regardless of the nitrogen level. Inadequate potassium resulted in excess winter injury, especially at high nitrogen levels.



Effect of K_2O rates with 0, 100, 200, and 400 pounds of nitrogen applied to Coastal Bermuda grass in 1955, 1956, and 1957 on the winter kill of Coastal Bermuda grass in 1957-58, Watkinsville, Ga.

Georgia

COASTAL BERMUDA UTILIZES SOIL NUTRIENTS AND WATER EFFICIENTLY

William E. Adams, Athens.--Coastal Bermuda grass grown in association with crimson clover on Cecil sandy loam recovered about 80 percent of the nitrogen applied in the fertilizer.

TABLE 1.--Nitrogen uptake by Coastal Bermuda grass for various nitrogen levels, Watkinsville, Ga., 1957

Treatments $N-P_2O_5-K_2O$ per acre	Total N uptake per acre	Calculated nitrogen recovery per acre	
Pounds	*Pounds*	*Pounds*	*Percent of applied*
0-200-200	65	---	---
100-200-200	139	74	74
200-200-200	235	170	85
400-200-200	369	304	76

This efficient utilization of nitrogen is reflected in the pounds of forage produced per pound of nitrogen which is shown in table 2.

TABLE 2.--Responses of Coastal Bermuda grass to nitrogen fertilization, Watkinsville, Ga., 1957

Treatments $N-P_2O_5-K_2O$ per acre	Average yield per acre	Average increase in yield due to applied N	Average increase in yield per lb. of applied N
Pounds	*Pounds*	*Pounds*	*Pounds*
0-200-200	4,560	---	---
100-200-200	9,140	4,580	46
200-200-200	12,740	8,180	41
400-200-200	15,080	10,520	26

Forage production increased with each increment of nitrogen. At the 100-N rate, an additional ton of hay (15 percent moisture) was produced for each 38 pounds of N. The efficiency was only slightly less at the 200-N rate, where a ton of hay was produced for each 50 pounds of N. Even at the 400-N rate, an additional ton of hay was produced for each 66 pounds of N.

The calculated recovery of phosphorus was 70 percent at the 50-P_2O_5 rate but dropped to only 27 percent at the 400-P_2O_5 rate (table 3).

TABLE 3.--Phosphorus recovered by Coastal Bermuda grass and crimson clover for the four levels of P_2O_5 Watkinsville, Ga., 1957

Treatments $N-P_2O_5-K_2O$ per acre	Total P_2O_5 uptake per acre	Calculated P_2O_5 recovery per acre	
Pounds	*Pounds*	*Pounds*	*Percent of applied*
400- 0-200	47	---	---
400- 50-200	82	35	70
400-100-200	89	42	42
400-200-200	101	54	27

The very deep root system of Coastal Bermuda grass, which extends beyond 6 feet, enables it to recover far more potassium than was applied. The potassium recovered for the four K_2O rates is shown in table 4.

TABLE 4.--Potassium recovered by Coastal Bermuda grass and crimson clover Watkinsville, Ga., 1957

Treatments N-P_2O_5-K_2O per acre	Total K_2O uptake per acre	Calculated K_2O recovery per acre	
Pounds	*Pounds*	*Pounds*	*Percent of applied*
400-200- 0	103	---	---
400-200- 50	164	61	122
400-200-100	250	147	147
400-200-200	401	298	149

This heavy feeding habit for potassium suggests that where Coastal Bermuda grass is grown under intensive management, annual soil tests should be taken to follow changes in potassium, as well as other soil nutrients. Low levels of K_2O should be increased for maximum production.

The utilization of water by Coastal Bermuda grass is shown in table 5. Water available was determined from rainfall data.

TABLE 5.--Relation of fertilizer level to the inches of water used per ton of Coastal Bermuda grass forage (oven-dry basis) produced Watkinsville, Ga., 1957

Treatments N-P_2O_5-K_2O per acre	Yield of Coastal Bermuda forage per acre	Water used per ton of forage
Pounds	*Tons*	*Inches*
0 - 0- 0	1.60	12.5
100- 50- 50	4.06	4.9
200-100-100	5.68	3.5
400-200-200	7.54	2.6

Under intensive management Coastal Bermuda appears to utilize water very efficiently. Above the 200-N level, the water required per ton of forage does not decrease very rapidly with increasing nitrogen rates.

Georgia

LIME IS IMPORTANT FOR ESTABLISHING COASTAL BERMUDA GRASS

A. E. Royer, Fleming.--Results the first year after planting indicate that lime has a marked effect upon the establishment of Coastal Bermuda grass on strongly acid Bladen clay loam soil.

Sixteen tons of calcitic limestone mixed in the soil surface raised the pH from 4.3 for unlimed soil to 6.3. Maximum crop response was reached at approximately 8 tons of limestone per acre with a soil reaction of 5.6. Plowing down all of the dolomite was less effective than mixing it with the surface soil.

A summary of some of the data is given in the accompanying table.

Effect of source, rate and method of incorporation of limestone on the yield of Coastal Bermuda grass, third harvest, August 12, 1958, Fleming, Ga.

Lime per acre	Yields of Coastal Bermuda grass per acre			
	Calcite	Dolomite	Dolomite (Plow-down)	Average
Tons	*Pounds*	*Pounds*	*Pounds*	*Pounds*
0...........	1,175	1,428	1,205	1,270
2...........	2,685	2,462	2,077	2,408
4...........	3,050	2,624	2,239	2,638
8...........	3,718	3,222	2,746	3,229
16...........	3,962	3,323	2,644	3,310
Means........	2,918	2,612	2,182	2,571

Georgia

FERTILITY LEVEL AFFECTS FROST HARDINESS OF GRASS

William E. Adams, Watkinsville.--Coastal Bermuda grass in a factorial experiment with four rates each of nitrogen, phosphorus, and potassium during 1955 to 1957 showed large differences in survival in the spring of 1958, following one of the severest winters on record.

A high K-N ratio was the key to good winter survival. Little winterkilling occurred with high levels of nitrogen fertilization, provided high levels of potash fertilization were maintained.

High nitrogen alone, however, rapidly depleted the available soil potash and severe killing occurred. In the absence of nitrogen fertilizer, growth was poor and the plant needs for potash were low. Thus, on the plots that received no nitrogen, little winter-killing occurred even where no potash was applied.

Mississippi

LEACHING OF FALL-APPLIED FERTILIZER NITROGEN STUDIED

Howard V. Jordan and Joe Sanford, State College.--Leaching of fall-applied nitrogen from fallow Southern soils, even of light surface texture, may not be so complete as is sometimes believed. This was shown in studies supplementing a project dealing with Fall vs. Spring Application of Nitrogen Carriers for Corn.

Three 10 x 10 foot sampling plots were located at the side of the main experiment. One of these received 100 pounds of nitrogen from sulfate of ammonia as a broadcast application in the fall when fall fertilizers were applied in the main experiment. A second received 100 pounds of nitrogen from nitrate of soda. The third was left untreated. The plots were sampled at intervals through the winter and at planting time in the spring. Samples from 0- to 3-, 3- to 6-, 6- to 12-, 12- to 18-, 18- to 24-, 24- to 30-, and 30- to 36-inch depths were analyzed for nitrate and ammonium nitrogen to follow the downward movement of these nitrogen fractions. The sampling plots were kept free of vegetation through the winter.

Data from sampling plots on Blakely sandy loam of the Coastal Plain in south Mississippi were collected in the winters of 1955-56 and 1957-58. This soil is a sandy loam to a depth of 10 to 12 inches; beneath is a sandy clay to clay loam. Surface soil is approximately pH 6.0 and deeper horizons range from pH 5.3 to 6.0. The surface soil

is low in phosphorus and contains approximately 100 pounds of exchangeable K_2O per acre.

In both years, nitrogen applied on the surface in the fall had moved below the plow layer before planting time in the spring, but most of it could be accounted for in the 6-18 inch depth of soil. In this position, it was availabe to corn roots. In the main experiment fall-applied nitrogen caused substantial increases in corn yields of the following year.

Rainfall in the interval between fall applications of nitrogen and spring planting totaled 17.98 inches in 1955-56 and 19.36 inches in 1957-58. The soil seldom freezes at this location. Thus, the conditions under which the experiment was conducted were quite favorable for leaching.

Illinois

DIFFUSION UNIMPORTANT IN ION ENTRY INTO ROOTS

J. T. Woolley, Urbana.--The mode of entry of water and ions into plant roots is under investigation in Illinois. One phase of the research program has dealt with the significance of intercellular space which extends from the root interface into the root tissue. Preliminary investigations revealed that such space might be available for free diffusion of ions into the roots. Recent data revealed, however, that neither salts, dyes, nor starch undergo rapid free diffusion into roots; that penetration was confined to cell walls; and that dyes moved only two to three cells into the roots in one hour.

These data rather strongly suggest that plant roots have very little "free-space", and that this mode of entry of ions is of little consequence.

Texas

SOIL TESTS FOR NITROGEN USELESS WITHOUT ADEQUATE IRRIGATION

A. C. Mathers, M. E. Jensen, and W. H. Sletten, Bushland.--Residual nitrogen studies on irrigated grain sorghum plots located on Pullman silty clay loam on the experiment station at Bushland, Texas, have shown that soil tests for nitrogen are of no value unless adequate water is available for the crop. It is also necessary to sample to a depth of 3 feet to get the best correlation of nitrate nitrogen with yield or nitrogen taken up by the tops.

Tables 1 and 2 show the correlation coefficients for yield with nitrate and nitrate plus fertilizer nitrogen in 1957 and 1958, respectively. The low correlation values on M_1 (preplant irrigation only) show that nitrogen is not the limiting factor under this condition. On M_3 (medium moisture level) and M_5 (high moisture level) the correlations increase to a depth of 3 feet, when no fertilizer is applied, showing that it is necessary to sample to that depth.

Fertilizer treatments applied in 1956 and 1958 were 0, 60, 120, and 240 pounds of nitrogen applied per acre. There was no yield response to these fertilizer applications in 1956. However, in 1957 the yield increased from 3,000 to 3,600 pounds on M_1, 5,600 to 6,800 on M_2, and 7,000 to 7,500 on M_5. On M_3, 120 pounds of nitrogen gave the maximum yield. However, on M_5, the highest yield was obtained where the 240 pounds of nitrogen had been applied the year before. In 1958, the yield was decreased from 2,800 to 2,400 pounds by adding nitrogen on the M_1 treatment. The yield was increased from 3,500 to 6,300 pounds by the addition of 120 pounds of nitrogen on the M_3 treatment; additional nitrogen made no difference in yield. On the M_5 treatment, yield was increased from 3,200 to 7,000 pounds by 240 pounds of nitrogen. However, the yield was 6,800 pounds where only 120 pounds of nitrogen was applied, and 60 pounds of nitrogen gave a yield of 5,800 pounds per acre. Nitrogen will increase yields after the soil has been under adequate irrigation for 2 or 3 years.

TABLE 1.--Correlation coefficients of residual nitrate nitrogen with yield, Bushland, Tex., 1957

Depth	Correlation coefficients		
	Moisture levels[1]		
	M_1	M_3	M_5
Feet			
1	0.524	0.370	0.235
2	.427	.310	.647*
3	.254	.467	.726**
4	.226	.473	.773**

TABLE 2.--Correlation coefficients of residual nitrate plus fertilizer nitrogen with yield, Bushland, Tex., 1958

Depth	Correlation coefficients		
	Moisture levels[1]		
	M_1	M_3	M_5
Feet			
1	0.206	0.687**	0.810**
2	.157	.682*	.810**
3	.208	.662*	.806**
4	.140	.658*	.768**

[1] M_1 Preplant irrigation.
M_3 Medium irrigation level.
M_5 High irrigation level.
*Significant at the 5 percent level.
**Significant at the 1 percent level.

Nebraska

LEGUMES INCREASE CORN YIELDS MOST IN FAVORABLE YEARS.

F. L. Duley, Lincoln.--On Sharpsburg silty clay loam in eastern Nebraska sweetclover in the rotation increased corn yields on the average for eight years. The increases were obtained when there was a good supply of moisture and corn could benefit from the nitrogen produced by the legumes. In the dry years, corn yields were lower on the sweetclover rotations, because sweetclover depleted the subsoil moisture. The results during eight years when all rotations are represented are shown in the accompanying table.

The rotations in which two years of sweetclover were included have been combined and compared with nonlegume rotation of corn, oats, and wheat. During the first five years, weather conditions were for the most part favorable for corn. The main exception was 1951, when excessive moisture cut corn yields on all plots. During these five years, the rotations that had sweetclover greatly increased the yield of corn.

In the last three years, when moisture was limited during the time when corn was making its heaviest demands for water, the yields of corn were reduced on the legume rotation compared with the nonlegume rotation. Furthermore, the mean yield for the last three years was lower on the plowed than on the subtilled land. This result has been demonstrated throughout much of the Nebraska work. Highest yields were obtained during wet years from plowed land, but during dry years, highest yields were obtained from subtilled land. Therefore, the method that would appear to have the advantage in any given locality depends on the relative number of wet and dry years.

Corn yields with different rotations, when same years are considered, Lincoln, Neb.

Rotation	Corn yield per acre								
	1948	1949	1950	1951	1953	1954	1955	1956	MEAN
					Subtilled				
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
SC, SC, W, C, O....	77.2	61.2	96.3	19.0	51.2	35.0	30.0	65.3	54.4
SC, SC, O, W, C....	73.5	65.9	77.0	28.5	45.5	31.6	21.5	72.1	52.0
SC, SC, C, C.......	78.4	45.1	81.0	19.6	35.9	17.4	24.4	36.4	42.3
MEAN...............	76.4	57.4	84.8	22.4	44.2	28.0	25.3	57.9	49.6
Corn-oats-wheat....	41.6	44.8	61.6	20.5	31.0	45.5	31.0	61.6	42.2
INCREASE FOR LEGUMES............	34.8	12.6	23.2	1.9	13.2	-17.5	-5.7	-3.7	7.4
					Plowed				
SC, SC, W, C, O....	84.2	61.2	106.8	21.9	54.1	35.6	23.6	58.8	55.8
SC, SC, O, W, C....	81.5	71.5	85.3	35.3	46.2	33.8	17.0	51.8	52.8
SC, SC, C, C.......	86.2	58.5	95.3	22.6	38.4	18.9	13.2	22.4	44.4
MEAN...............	84.0	63.7	95.8	26.6	46.2	29.4	17.9	44.3	51.0
Corn-oats-wheat....	52.0	43.2	64.2	21.2	35.9	42.9	31.9	59.8	43.9
INCREASE FOR LEGUMES............	32.0	20.5	31.6	5.4	10.3	-13.5	-14.0	-15.5	7.1

North Dakota

PLANTS AND FERTILIZATION INFLUENCE SOIL NITROGEN STATUS

G. O. Boatwright, H. J. Haas, D. L. Grunes, and G. A. Reichman, Mandan.-- Soil nitrogen analysis indicates that soil cropped to crested wheatgrass and alfalfa from 1949-1955 followed by wheat from 1956-1957 substantially increased in nitrogen content during the entire period. Smaller soil nitrogen gains were also measured in soil previously cropped to crested wheatgrass and sweetclover. However, soil previously cropped to crested wheatgrass or to continuous wheat decreased considerably in total nitrogen content. The decrease was approximately equal for these two cropping treatments. These data suggest that crested wheatgrass is no better than continuous wheat for maintaining the nitrogen status of the soil. However, both alfalfa and sweetclover in

combination with crested wheatgrass appear to be useful for maintaining or in most cases increasing the nitrogen status of the soil.

The study was initiated on Cheyenne fine sandy loam in 1949 by seeding individual plots to wheat, crested wheatgrass, crested wheatgrass and alfalfa or to crested wheatgrass and sweetclover. Nitrogen alone or in combination with phosphorus was applied to some of the plots as an additional variable. The plots were split by leaving one-half of each plot unharvested, while plant material on the other portion of the plot was harvested and removed. (All plant material was mowed and left on the plot from 1949-1955.) Each treatment was replicated three times. In the fall of 1955, all sod plots were plowed and since that time have been cropped to wheat. Soil samples were collected at the time of initiation, in 1955, and again in 1957. Total nitrogen determinations of both soil and plant samples were made, and some of the data are presented in the accompanying table.

All plots getting nitrogen, irrespective of cropping treatment, lost less nitrogen than nonfertilized plots. Some of the continuous wheat and crested wheatgrass plots which received fertilizer lost very little nitrogen. In some cases, soil nitrogen gains were measured, although nitrogen removal by the crop was greater due to fertilization. This indicates that, by fertilization, continuous wheat can be grown without serious soil nitrogen losses. Where crested wheatgrass is grown, nitrogen losses can be expected unless fertilization is practiced. Phosphorus applications to crested wheatgrass and alfalfa mixtures resulted in less gain in soil nitrogen than occurred in nonfertilized treatments. Also, it should be noted that the increase in nitrogen removed by the crop was small and did not account for the differences in soil nitrogen gains. Phosphorus applications to crested wheatgrass and sweetclover were erratic, thus no conclusions can be drawn until further laboratory analyses are made.

Generally, where soil nitrogen losses were encountered, nonharvested plots lost less nitrogen than did the harvested plots. Two exceptions were when crested wheatgrass received no fertilizer and when continuous wheat (series VII) received nitrogen and phosphorus. Where soil nitrogen gains were measured, the gain was greater because of the nonharvesting treatment. Since soil nitrogen was influenced by harvesting treatment, it should be pointed out that, with one exception, soil nitrogen differences were not as great as the amount of nitrogen removed by the harvested crop. Thus, it is suggested that nonharvested crops tend to improve the soil nitrogen status, however, the efficiency of such practices appears to be low.

Soil nitrogen loss or gain due to different cropping and fertilizer treatments, Mandan, North Dakota, 1949-1957

Cropping treatment[1] 1949-55		Fertilizer treatment[2]		Soil N loss or gain per acre 1949-57	N. added in fertilizer per acre 1949-57	Soil & fert. N loss or gain per acre 1949-57	N. removed per acre 1949-57	N. unaccounted for per acre 1949-57
		1949-55	1955-57					
Series VII								
				Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Wheat	H	0-0	0-0	-238	---	-238	135	-103
	NH	0-0	0-0	-170	---	-170	47	-123
	H	30-30	30-30	-115	260	-375	178	-197
	NH	30-30	30-30	-136	260	-396	71	-325
Crested wheatgrass	H	0-0	0-0	-238	---	-238	82	-156
	NH	0-0	0-0	-391	---	-391	52	-339
	H	30-0	0-0	-51	210	-261	181	-80
	NH	30-0	0-0	0	210	-210	57	-153
	H	30-30	0-0	-17	210	-227	188	-39
	NH	30-30	0-0	+34	210	-176	53	-123
	H	60-0	0-0	-51	420	-471	241	-230
	NH	60-0	0-0	+102	420	-318	57	-261
	H	60-30	0-0	+119	420	-301	291	-10
	NH	60-30	0-0	+204	420	-216	66	-150
Series VIII								
Wheat	H	0-0	0-0	-323	---	-323	108	-258
	NH	0-0	0-0	-204	---	-204	44	-160
	H	30-0	30-0	-17	260	-277	149	-128
	NH	30-0	30-0	+17	260	-243	52	-191
	H	30-30	30-30	-34	260	-294	154	-140
	NH	30-30	30-30	+187	260	-73	67	-6
Crested wheatgrass and alfalfa	H	0-0	0-0	+255	---	+255	638	+893
	NH	0-0	0-0	+425	---	+425	61	+486
	H	0-30	0-0	+119	---	+119	675	+794
	NH	0-30	0-0	+374	---	+374	56	+430
Crested wheatgrass and sweetclover	H	0-0	0-0	0	---	0	211	+211
	NH	0-0	0-0	+289	---	+289	54	+343
	H	0-30	0-0	+102	---	+102	172	+274
	NH	0-30	0-0	+136	---	+136	55	+191

[1] H and NH represent harvested and nonharvested, respectively.
[2] Pounds of nitrogen and P_2O_5 per acre, respectively.

AVAILABILITY OF FIXED-NH_4 DEPENDS ON K LEVEL OF SOIL

G. E. Leggett and C. L. Crawford, Prosser. --Results obtained from a pot experiment indicate that the availability of fixed-NH_4 in the soil is decreased by additions of potassium fertilizer.

Previous work in the laboratory showed that fixed-NH_4 was released from soil minerals during alkaline distillation or aeration by cations such as sodium, calcium, and magnesium. These cations are not fixed by soil minerals in the same manner as are ammonium ions. On the other hand, when small amounts of soluble potassium were added along with large amounts of these cations in the alkalizing solution, it was shown that the added potassium prevented the release of the fixed-NH_4. This is because potassium ions are fixed by the same minerals and manner as are ammonium ions. These studies indicated that increased levels of potassium present in the soil on which plants were growing possibly would act in the same manner and, thus, reduce the efficiency of NH_4-type fertilizer in soils capable of fixing ammonium.

The soils used in the experiment were the surface layer of Ritzville very fine sandy loam which does not fix significant quantities of ammonium, and the surface layer of an eroded Palouse silt loam which is capable of fixing under moist conditions approximately 2.0 meq. of ammonium per 100 g. (560 pounds of nitrogen per acre 6 inches). These soils were placed in pots, and solutions containing ammonium sulfate were added to give 2 levels of nitrogen fertilization. They were then treated with solutions containing potassium sulfate. Sudan grass was planted and allowed to grow for approximately 3 months. The above ground portions of the plants were clipped twice during that period. The yield and total nitrogen content of the plants were determined.

The results of the experiment are given in the accompanying table. They show that increasing levels of potassium in the soil did not affect the yield or the nitrogen content of the Sudan grass grown on Ritzville soil. This soil, as mentioned before, does not fix ammonium. On the other hand, applications of potassium to Palouse soil resulted in serious decreases in the amounts of nitrogen taken up by the plants at both levels of nitrogen fertilization. The decreases noted where 400 mg. potassium was added to this soil, as compared to where no potassium was added, amounted to 32 percent of the nitrogen applied at the 100 mg. nitrogen level, and 20 percent of that applied at the 300 mg. nitrogen level. Also, the yield was decreased markedly when both ammonium and potassium were added to this soil at the highest rates.

The effect of potassium on the yield and nitrogen uptake of Sudan grass grown on two soils, Prosser, Wash.

Soil treatment per pot		Yield-plant tops per pot		Nitrogen in plant tops per pot	
Nitrogen	Potassium	Ritzville	Palouse	Ritzville	Palouse
Milligrams	*Milligrams*	*Grams*	*Grams*	*Milligrams*	*Milligrams*
100	0	7.5	5.7	87.0	90.1
100	200	7.6	5.6	85.0	77.5
100	400	7.5	4.4	88.0	58.1
300	0	14.4	12.5	244	234
300	200	13.3	11.4	241	217
300	400	14.2	8.7	246	174

The results of this experiment parallel those obtained from the earlier laboratory study and indicate that some of the ammonium added to the Palouse soil was fixed by the soil minerals and that increasing levels of potassium resulted in a greater portion of the fixed-NH_4 being retained by the minerals and unavailable to plants. These results also indicate that ammonium fixation by soil minerals may be an important factor to consider under field conditions, since many soils contain minerals which are capable of the fixation. It may be especially important where application of both nitrogen and potassium are necessary for maximum crop production. Additional work is under way to determine if the effect noted in this experiment can be minimized by different methods of application of the ammonium and potassium fertilizers.

New York

COBALT STATUS OF SOILS ON EASTERN COASTAL PLAIN

Joe Kubota (SCS) and Victor A. Lazar, Ithaca. --The Ground-Water Podzols are associated with a deficiency of cobalt in native forages grazed by cattle in southeastern United States.

Fifty-three soil sites were located in five States from North Carolina to Texas. The soils included Regosols, Ground-Water Podzols, Red-Yellow Podzolics, Low Humic-Gleys, Humis-Gleys, and their intergrades to other kinds of soils.

The cobalt values in vegetation from the Ground-Water Podzol sites were markedly lower than those from the other soil sites. Values were also consistently lower than those on soils having comparable texture but differing in genesis from the Ground-Water Podzols. The cobalt values were consistently high in samples from Alabama, Mississippi, and Texas. These results are consistent with the absence of both reported areas of Ground-Water Podzols and of reported problems of cobalt deficiency in cattle in these States.

New York

COBALT RESPONSE MEASURED IN THE NORTHEAST

Kenneth C. Beeson, Ithaca. --An application of 5 pounds of cobalt as cobalt sulfate applied to a Paxton loam or a Gloucester fine sandy loam increased the cobalt concentration in timothy from 0.03 p. p. m. to more than 1.0 p. p. m. in the first year. Cattle needs are met with a concentration of about 0.1 p. p. m.

The residual effects of the cobalt treatment were evident for 8 years. At the end of 10 years, the level of cobalt in the timothy had dropped below that required by cattle.

A two-pound application of cobalt was effective for only two years. Less than one percent of the cobalt applied was recovered in the forages.

New York

ALFALFA STILL GROWING LATE IN THE FALL

E. R. Lemon, Ithaca. --Plant growth over short time periods can be measured by studying the pattern of carbon dioxide concentration over the crop.

Micro meteorological data demonstrating the influence of a crop on carbon dioxide content of the air are given in the table. Temperature and carbon dioxide were taken at the indicated levels above an alfalfa-brome field in November 1958 at Ithaca. The following points are of interest:

(a) During daylight, carbon dioxide decreases downward (photosynthesis is using carbon dioxide), and during nighttime hours carbon dioxide increases downward (respiration is giving up carbon dioxide) or stays the same.

(b) Strongest decrease downward in carbon dioxide is near noon, when sun is brightest (photosynthesis greatest), while strongest increase downward occurs shortly after sundown (respiration greatest).

One concludes that the alfalfa-brome field was still making net gains in dry matter even late in the fall.

Carbon dioxide and temperature above alfalfa-brome grass, Ithaca, N. Y. 1958

November 4

Height	3:40 p.m.		5:30 p.m.	
	CO_2	Temp.	CO_2	Temp.
cm.	*p.p.m.*	°C	*p.p.m.*	°C
200*	284	11	296	6
120	277	11	298	5
80	270	12	300	2
40	crop height			
0	ground level			

November 5

Height	6:37 a.m.		8:47 a.m.		12:20 p.m.	
	CO_2	Temp.	CO_2	Temp.	CO_2	Temp.
cm.	*p.p.m.*	°C	*p.p.m.*	°C	*p.p.m.*	°C
200*	293	0	282	9	282	15
120	288	0	260	9	252	15
80	280	-1	250	9	241	16
40	crop height					
0	ground level					

*200 cm. = 6-1/2 feet
Sunrise - 7:15 a.m.
Sunset - 4:20 p.m.

CLIMATIC FACTORS AFFECT TREATMENT RESPONSES IN CORN

Jesse W. Collier and Richard M. Smith, Temple.--In a corn production study largest variations in yields were caused by years, irrigation, and cropping system. Yield responses from certain cropping system-treatment combinations were not the same each year of the study. Distribution of rainfall and maximum temperatures just before and after silking appear to influence relative yields and also maximum yields. These data emphasize the importance of a careful study of climatic factors as they affect results of production experiments.

This experiment was conducted on Houston Black clay near Temple, Texas, over a 6-year period from 1952-1957. Cropping systems compared were continuous corn and corn after sweetclover. Irrigation and nitrogen fertilization treatments were made in each cropping system. Irrigation was usually added during the period from the first of June through the first week of July. Average date of silking is about June 10. Amounts of water applied varied from 4.5 acre-inches in 1957 to 12 acre-inches in 1954. Nitrogen fertilization included an application of 90 pounds of N per acre before planting corn. The plant population reported here was 12,000 plants per acre.

Corn yield data during the period from 1952 through 1957 are shown on the accompanying table. Nonirrigated plots following sweetclover produced higher yields than similar plots from continuous corn in 5 of the 6 years, or in each year except 1955. Corn yields from nonirrigated continuous corn in 1955 were about 10 bushels per acre higher than from corn following sweetclover. When additional water was applied, yields were highest from corn following sweetclover. These data suggest that there was a greater deficit of soil moisture in plots following sweetclover in 1955 due to heavier use by the sweetclover preceding the corn and also to the low amount of rainfall in the preceding fall and winter. Corn used very little water after July 15 in 1954, while the biennial sweetclover used water until plowed out in the fall. Either early plow out of biennial sweetclovers or the use of an early maturing annual sweetclover seems advisable if a row crop is to follow the sweetclover.

Six-year averages showed an increase in yield from addition of nitrogen to nonirrigated continuous corn plots, but these increases were not consistent. In 1952, 1954, and 1957, the responses to nitrogen were significant, but, in the other three years, no increases were obtained. These data emphasize the close balance between fertility of the soil under intensive cropping and yields that are usually limited by natural climatic factors.

Although the general effect of irrigation was to increase yields, the amount of increase over nonirrigated plots was dependent on both soil fertility level and climatic factors. Yields from high-fertility plots that received only natural rainfall were low in 1953, 1954, and 1956, and additional water caused increases of from 24 to 57 bushels per acre. Rainfall during 1955 was favorable for corn production and so were other climatic factors, particularly low maximum temperatures after silking, and additional water resulted in rather large increases in yields over nonirrigated, high-fertility plots. Smallest responses to irrigation occurred in years with very good rainfall distribution in May and June.

The use of applied water in terms of yield was also affected by years, although some of this variation can be attributed to the differences in time of application. Least efficient use of applied water occurred in 1957 when water applications were begun June 17 or a week after silking. Most efficient use of irrigation water occurred in 1955, largely because temperatures remained exceptionally low until the corn was mature.

If yields for 1956 are omitted, because of very poor stand, there is a definite relationship between maximum yields from the irrigated plots following sweetclover and temperatures just before and after silking. The highest correlation was obtained

between maximum yields and the mean maximum temperature for the period from a week before silking to 3 weeks after silking. If corn silks on the average date, this period corresponds to the month of June. Highest yields were obtained in 1955 when the mean maximum temperature for June was 89° F., and lowest yields were obtained in 1953, 1954, and 1956 when the mean maximum temperatures for June were either 95° F. or 96° F. This relationship suggests the importance of factors other than rainfall and soil fertility in corn production.

Corn yields as affected by cropping system and treatments, Temple, Tex. 1952 to 1957

Cropping system	Nitrogen fertilization	Corn yield per acre						
		1952	1953	1954	1955	1956	1957	Average
		Nonirrigated						
	Pounds	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
Continuous corn...	0	54	31	29	62	19	38	39
	90	64	28	40	63	23	55	46
Corn-sweetclover..	0	72	35	48	53	38	76	54
	90	66	30	44	49	38	77	51
		Irrigated						
Continuous corn...	0	58	54	28	54	32	42	46
	90	86	64	86	95	61	63	76
Corn-sweetclover..	0	93	85	89	106	73	94	90
	90	92	82	85	105	64	96	87

Colorado

SORGHUM YIELDS AFFECTED BY ROTATION AND PLANTING METHODS

B. W. Greb and A. L. Black, Akron.--A grain sorghum production experiment at Akron described in Quarterly Report No. 11 has indicated significant trends in production affected by various rotations and planting methods for the two crop seasons tested. Listed below are several of the more obvious trends obtained in field observations, experience, and experimental data:

1. Lister planting grain sorghums on hardland soils in the western portion of the Central Plains is a dubious practice because of delayed maturity, poor germination and stand obtained in cold seedbeds, and cost of operations.

2. Weed competition has accounted for greater differences in yields for a given year than the differences in volume of initial stored soil moisture at seeding time by various rotations. Weed competition is highest on sorghum after sorghum, intermediate on sorghum after wheat, and least on sorghum after fallow.

3. Control of weeds is almost prohibited on drilled 14-inch width rows except by spraying or on summer-fallow soil. Spraying of sorghum for weeds has delayed maturity.

4. Plant population should average 25,000 to 50,000 per acre to take advantage of soil moisture but not cause excessive early water consumption.

5. With all factors involved, production of grain sorghum appears most optimum under a fallow-wheat-sorghum rotation surface drilled in 28- or 42-inch width rows and cultivated twice before the first of August.

Yield and stand counts of grain sorghum, Akron, Colo., 1957, 58

Treatments		1957		1958	
Planting method	Rotation	Plants per acre	Yield per acre	Plants per acre	Yield per acre
		Thousands	*Bushels*	*Thousands*	*Bushels*
Drilled 14" rows...	S-S	47	8.7	20	0.0
	F-W-S	51	15.3	33	7.0
	F-S	84	35.3	34	15.7
	Average	61	19.8	29	7.6
Drilled 28" rows...	S-S	66	29.0	29	7.7
	F-W-S	62	25.7	38	18.3
	F-S	57	33.7	36	21.7
	Average	62	29.5	34	15.9
Drilled 42" rows...	S-S	41	30.0	30	17.3
	F-W-S	57	27.0	36	19.7
	F-S	50	43.7	37	25.0
	Average	46	33.6	34	20.7
Listed 42" rows...	S-S	27	19.3	16	*7.5
	F-W-S	14	16.3	12	14.0
	F-S	23	23.0	17	*10.5
	Average	21	19.5	15	10.7
L.S.D. (.05)		18	10.2	8	5.7

Av. for rotations	1957			1958		
	Moisture at seeding time	Plants per acre	Yield per acre	Moisture at seeding time	Plants per acre	Yield per acre
	Inches	*Thousands*	*Bushels*	*Inches*	*Thousands*	*Bushels*
S-S	9.2	45	21.8	7.0	24	8.1
F-W-S	8.9	43	21.1	5.7	31	14.8
F-S	7.9	53	33.9	8.8	31	18.1

*Immature.

Colorado

MANAGEMENT OF SORGHUM RESIDUES UNDER INVESTIGATION

B. W. Greb and A. L. Black, Akron.--Sorghum production on any given field in the Central Plains is usually succeeded by summer fallow. Thus, the desirability and feasibility of using sorghum stubble for surface protection against wind and water erosion is involved on an extensive acreage in the area.

A recently installed experiment at Akron is designed to measure quantities of sorghum residues during various climatic periods for natural losses (wind and weathering) and for residue losses by tillage with a variety of common farm implements. The objectives involved are similar to those involving wheat stubble for fallow purposes; that is, maximum field protection by residues, control weeds, keep tillage costs and tillage difficulties at a minimum, and prepare an optimum seedbed for the succeeding crop. It is expected that choice of implements and time of use will vary with climatic conditions and the quality and quantity of sorghum residues.

Treatments were started in October 1958 on a long narrow 20-acre field of sorghum stubble which was divided into fall versus spring tillage (6 each). Some of the treatments include continuous use or combinations of sweep, spray, tandem disk, one-way, rod weeder and mowing.

Preliminary evidence indicates there is no substitute for undisturbed sorghum stubble for overwintering purposes. Fall tillage of any kind increases residue losses by wind of leaf material and shredded stalks. Fall tillage also increases the loss of snow and causes wind channels to develop on undulating land when the stalks are down.

Arizona

GROWTH AND FRUITING OF TALL COTTON

C. O. Stanberry and R. H. Maier, Yuma, and Tucson. --Tall cotton - Short yields is the claim by farmers in southwestern Arizona. Cotton growers there have experienced considerable difficulty with rank cotton. They reported that tall cotton, in some cases 7 to 9 feet high, lodged and was difficult to pick. Also, yields were considered below normal.

USDA and University of Arizona scientists made surveys obtaining detailed information and soil samples from 18 widely distributed fields in the Wellton-Mohawk District. Cultural treatment data from growers, and field data were obtained from 10 sites each for short, medium, and tall cotton plants within each field. These were:

1. Location of short, medium, and tall plants to determine if position in the irrigation run was important.

2. Individual heights of the 10 cotton plants in each category.

3. Number of bolls per plant. Since much of the cotton had been harvested, any estimate of yield could be made only by counting empty burrs.

4. Position of boll-set on the stalk - bottom, middle, top, or general.

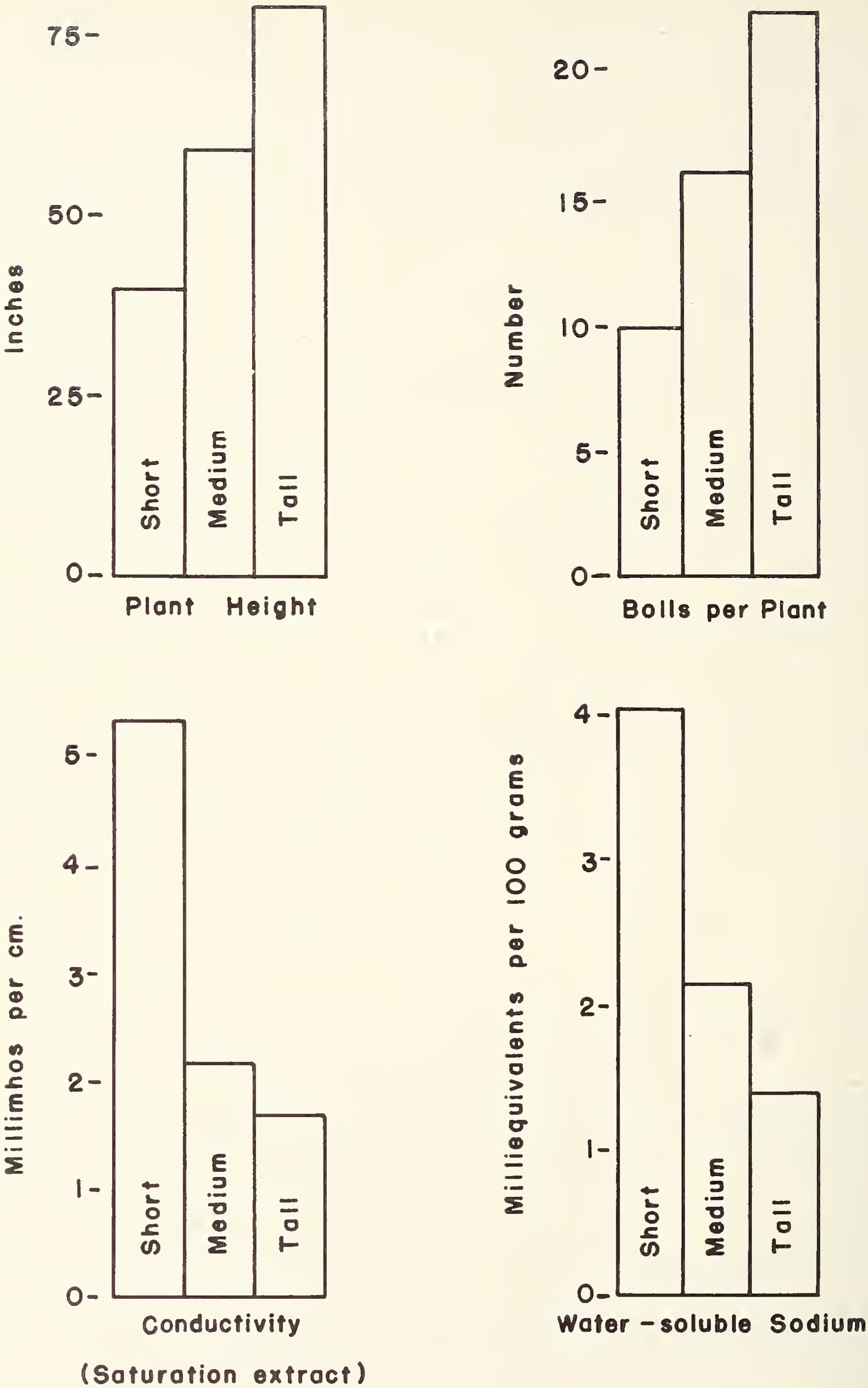
5. Soil samples were obtained to a depth of 12 inches, 4 to 8 inches from each selected plant. All 10 samples within a given field were composited for each plant height.

6. Six soil profiles in each field were sampled to 36 inches for observational purposes.

Ten separate chemical determinations were made on each of the 54 soil samples, plus mechanical analyses (sand, silt, and clay) on representative samples.

Data in the bar graphs are averages for the 18 cotton fields. Values varied somewhat among different soils, but trends were consistent. Bolls per plant were related to plant height, with the greater number on the taller plants. Cattle had grazed one field, making a reliable boll estimate difficult. In two or three others some early bolls had been snapped. For all fields, however, a strong correlation existed between plant height and boll number. Immature or abnormally small bolls were not counted. Actual cotton yields are unknown, since there may have been some difference in boll size between short, medium, and tall cotton. Boll position for all heights was comparable in a given field. Plant height was not related to location in the irrigation run.

The bar graphs indicate that large amounts of salt or water-soluble sodium are associated with shorter cotton and fewer bolls. It is believed that salt and/or sodium were the factors which limited plant growth and number of bolls.



Relationship of certain soil properties and plant characteristics to observed height of cotton plants, Arizona, 1958

Results are too variable to tell if percent sodium saturation, exchangeable sodium, or water-soluble potassium influenced cotton growth or yield. It does appear that exchangeable potassium, percent potassium saturation, pH of soil paste, pH of a 1:5 soil: water suspension, and base-exchange capacity did not affect plant height or bolls per plant. In soils selected for mechanical analyses, no consistent trends could be correlated with plant growth.

A chemical survey of a soil from one field of tall cotton in question, detected an oversupply of nitrate nitrogen. A discussion of irrigation practices with growers points to the probable contribution of excess nitrogen and water in excessively tall cotton. Too much nitrogen encourages plant growth, whereas heavy irrigation removes salt and water-soluble sodium. Additional research in irrigation and fertilization, and their influence on cotton physiology should lead to a better understanding of how to obtain the desired control of plant height and fruiting.

L. Cooper and R. Brumley assisted in the field survey and F. Pretzer and N. Baldar in the chemical analyses.

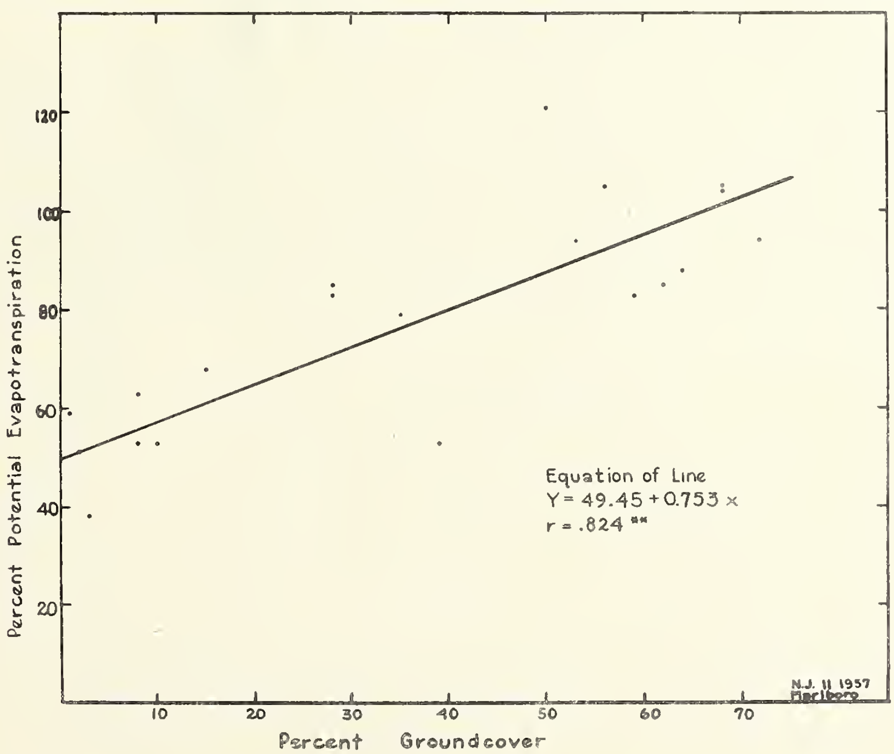
MOISTURE CONSERVATION

New Jersey

PLANT STAGE OF GROWTH AFFECTS EVAPOTRANSPIRATION RATE

N. A. Willits, W. E. Marlatt, and G. D. Brill, New Brunswick. --Snap beans were planted on seven different dates in 1957. The plantings were so spaced, that for any period, soil moisture loss could be measured at two or more stages of growth. Water loss was determined by gravimetric sampling in each of three replicated plots. Percent ground cover was determined from photographs made weekly.

The data, plotted in the accompanying figure, revealed that evapotranspiration increased with increasing ground cover, as long as the plants were in a vegetative stage



Relationship between ground cover and potential evapotranspiration of snap beans, New Brunswick, N. J., 1957

of growth. The straight-line relationship was disturbed when blossoming and fruit set commenced. Extrapolating the line to 0 percent ground cover revealed that 50 percent of the potential evapotranspiration calculated from climatic data was lost as evaporation. This corresponds to a daily loss of about 0.075 inches per day.

If soil moisture under a row crop is to be evaluated by use of climatic data, the predicted losses will have to be adjusted upwards until the plant foliage covers most of the ground or until the onset of blossoming.

North Carolina

WATER-USE BY CORN WAS GREATER THAN BERMUDA GRASS

D. G. Harris and C. H. M. van Bavel, Raleigh.--Measurements of water-use, when soil and plant factors were not limiting, indicated that evapotranspiration from corn is somewhat greater than from Bermuda grass. The water-use of each crop and the difference in water-use of corn and Bermuda grass can be explained almost entirely upon the basis of the net radiation received at the surface of the crop. Net radiation (H in the accompanying figure) was approximately 15 percent greater over corn than over Bermuda grass.

Examination of the accompanying figure shows that water-use from the corn was about 15 to 20 percent greater than from the Bermuda grass and approximately 9 percent greater than the estimate of water-use, assuming that 80 percent of the energy for net radiation is used for evapotranspiration.

Investigations are continuing with corn and Bermuda grass. Studies with corn will include the effect of mulching and shading of the soil upon total evapotranspiration.

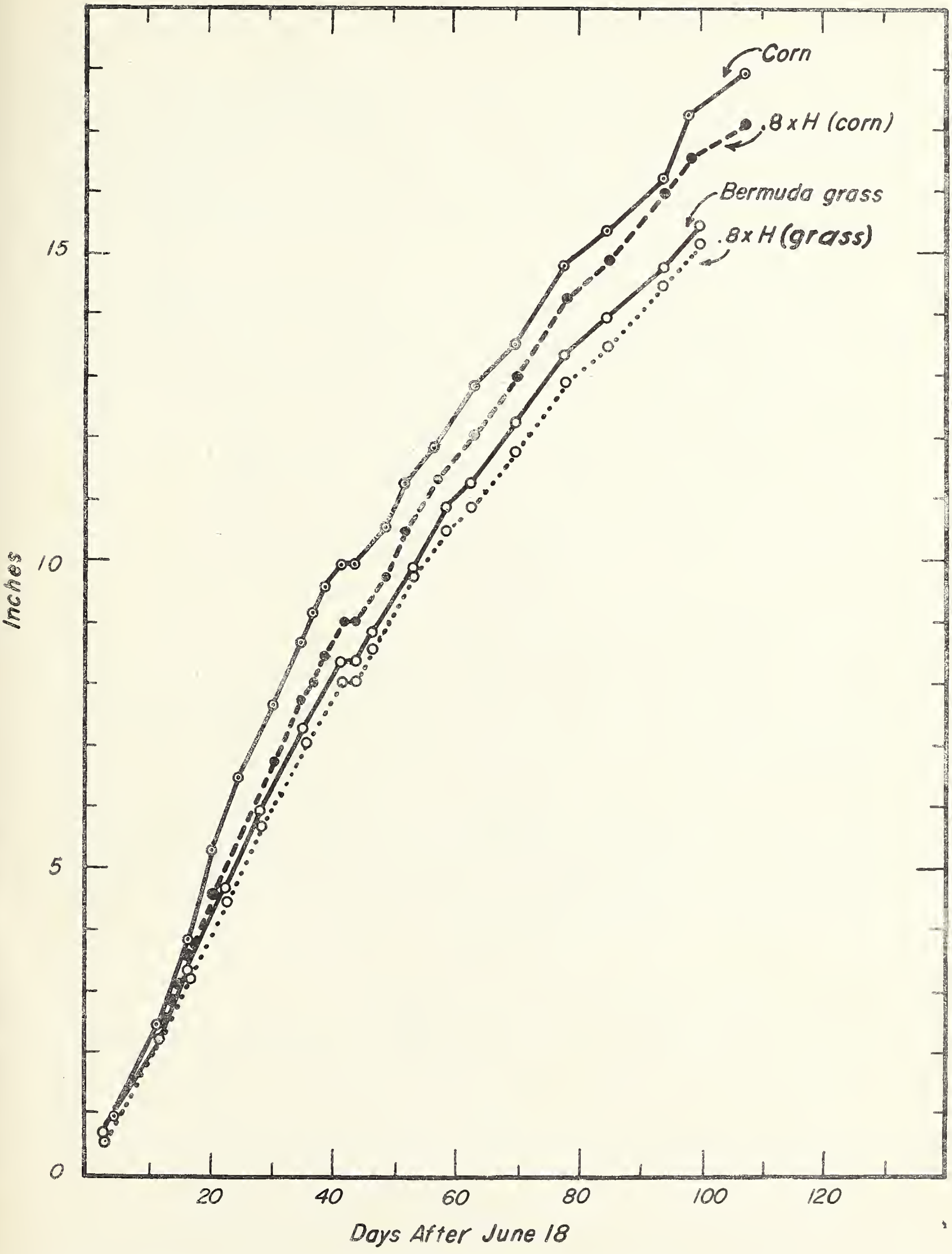
Kansas

SOIL SURFACE TREATMENT INFLUENCES NET RADIATION

R. J. Hanks and S. A. Bowers, Manhattan.--Measurements made at Manhattan during 1958 show that soil surface conditions influence net radiation and soil temperature. Table 1 shows the average net radiation measured during May to August. The treatments consisted of an untreated plot (check), one inch of gravel painted black (black), one inch of gravel painted aluminum (aluminum), four tons of straw (straw) and ridges covered (about one-half of total area) with 4-mil polyethylene plastic (plastic). The plots with black-painted gravel had the highest net radiation followed by the plastic, check, straw, and aluminum plots. The black and aluminum plots were the same except for the color of the surface but were the most different as far as net radiation is concerned.

TABLE 1.--Influence of soil surface condition on net radiation in langleys per day, Manhattan, Kans.

Total radiation	Net radiation				
	Check	Black	Aluminum	Straw	Plastic
594....................	295	341	274	276	309
Percent of total.......	50	57	46	46	52



Accumulated evapotranspiration from Bermuda grass and corn for the period June 18 to October 2, 1957, compared with calculated values, Raleigh, N. C. (H is a measure of net radiation).

Table 2 shows the temperature measurements made under these surfaces. The data show the plastic plot to be the hottest and the straw plot to be the coolest. This difference in the extremes was about 19° F. at 1 cm., 15° F. at 4 cm., 11° F. at 16 cm., 6° F. at 64 cm., and 2.5° F. at 152 cm. The high temperature under the plastic is undoubtedly due to the decreased ventilation under the plastic resulting in the well-known "greenhouse effect." The higher temperature of the check plot over the black plot is due to the better insulative value of the gravel mulch which was evidently sufficient to more than equal the increase in net radiation of the black over the check. The higher temperature under the black surface compared to the aluminum was a reflection of the increased net radiation of the black plot. The higher temperature under the aluminum compared to the straw plot is probably an indication that the straw mulch was a better insulator than the gravel mulch.

TABLE 2.--Influence of soil surface condition on soil temperature, Manhattan, Kan.

Depth	Check	Black	Aluminum	Straw	Plastic
cm.	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*
1	84.4	81.3	77.7	74.9	93.9
4	82.5	80.8	77.8	74.5	89.3
16	80.3	78.9	75.6	73.3	84.3
64	75.0	74.0	71.6	70.6	76.8
152	67.7	67.4	66.0	65.9	68.2

Wisconsin

ELIMINATING EVAPORATION CONSERVES WATER

R. E. Taylor, LaCrosse.--During the 1957 growing season water loss from lysimeters planted to corn was cut in half by eliminating evaporation, yet there was very little effect on dry matter produced. These data substantiated the Illinois and Ohio observations that evaporation accounted for approximately 50 percent of the total water used in evapotranspiration.

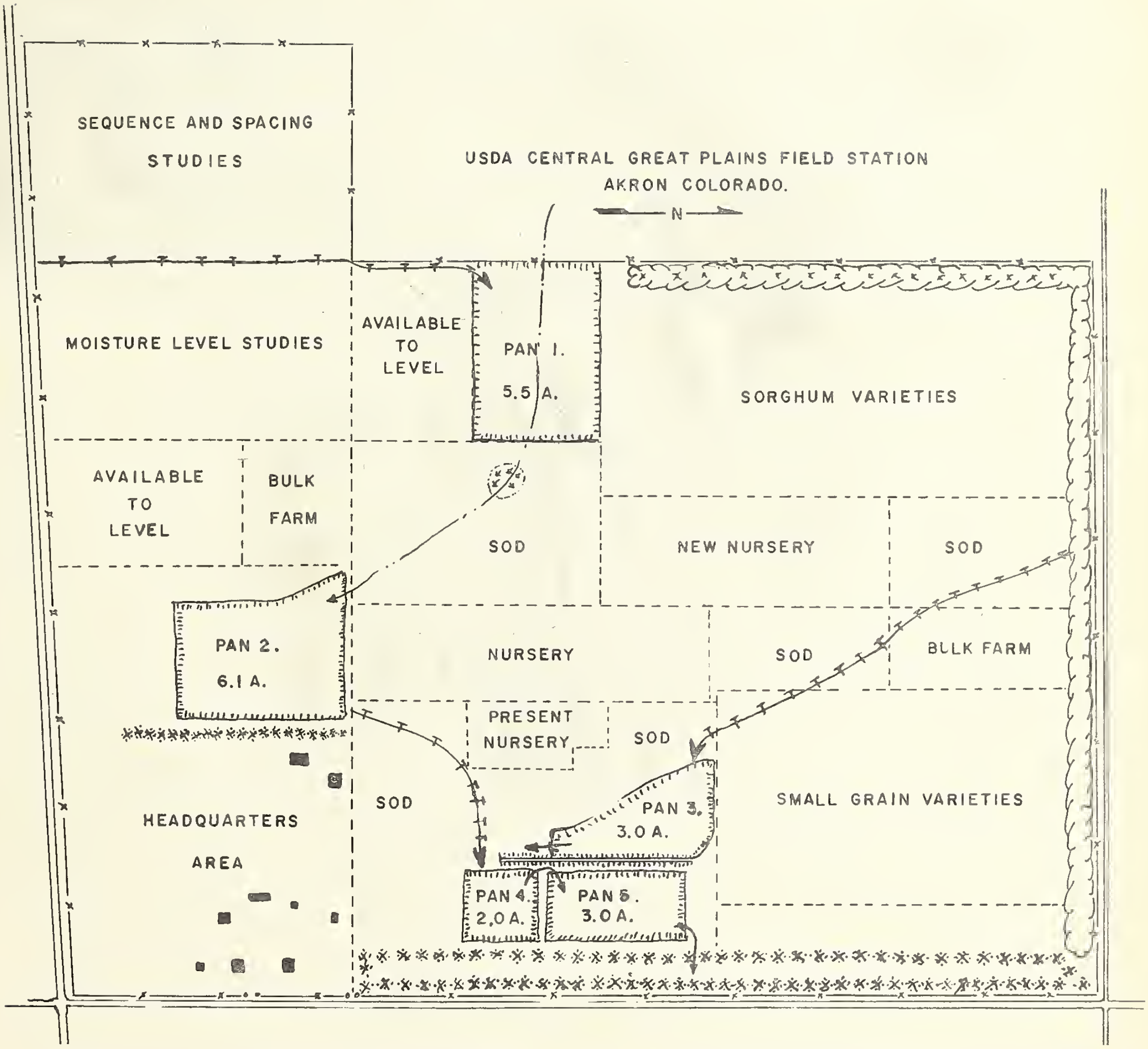
The early season rate of growth of corn plants was greater on lysimeters where plastic covers were used to eliminate evaporation from the soil surface than on uncovered lysimeters. This probably resulted from higher soil temperatures in the covered lysimeters. The plastic with the film of water that usually forms on the underside is a very effective heat trap and causes higher soil temperatures until the corn plants are large enough to effectively shade the soil surface.

Colorado

LEVELING DRYLAND VALLEYS TO PRODUCE CROPS

M. B. Cox, Akron.--Runoff water can and should be stored for crop production in the Central Great Plains. The first 2 of a series of level pans have been completed at the USDA Central Great Plains Field Station, Akron, Colorado, for utilizing runoff water to produce crops annually on nonirrigated land. A total of 5 pans will be installed along the main water course through the station and cropped to sorghums, alfalfa, and grasses. Runoff water from approximately 700 acres of cultivated land drains onto the station from the west in a broad flat drainage way.

This water will flow through pan 1 with none retained after the flow ceases. Pan 2 will be dyked to retain 6 inches of water before the overflow passes on to pans 4 and 5. See accompanying map of the station. Pan 3 receives the runoff from 45 acres that is brought to the pan by a diversion terrace. This diversion will be equipped with a rate


SEQUENCE AND SPACING STUDIES
USDA CENTRAL GREAT PLAINS FIELD STATION
AKRON COLORADO.
N
MOISTURE LEVEL STUDIES
AVAILABLE TO LEVEL
PAN 1.
5.5 A.
SORGHUM VARIETIES
AVAILABLE TO LEVEL
BULK FARM
SOD
NEW NURSERY
SOD
PAN 2.
6.1 A.
NURSERY
SOD
BULK FARM
PRESENT NURSERY
SOD
SOD
PAN 3.
3.0 A.
SMALL GRAIN VARIETIES
HEADQUARTERS AREA
PAN 4.
2.0 A.
PAN 5.
3.0 A.

measuring flume for determining the amount of extra water that is delivered to the area. The initial studies planned for these areas include alfalfa varieties, grain sorghum varieties, forage sorghum varieties, smooth brome grass and alfalfa-grass mixture.

Colorado

STUBBLE MULCH SAVES EXTRA SOIL MOISTURE IN EASTERN COLORADO

B. W. Greb and A. L. Black, Akron.--Recent evidence indicates that for the climatically drier portion of the Central Great Plains, keeping some wheat residues on the surface of the soil during summer fallow will save more water than clean tillage. Savings have ranged from one-half to two inches more available water by wheat seeding time on stubble-mulch fallow compared with burial of residue (plow and/or disk) at Peetz and Akron, Colorado.

Most of the stubble in this area is allowed to stand over winter and early spring with the first fallow tillage beginning late in April or early May. Usually 50-60 percent of the total available soil moisture to be stored by fallow has already entered the soil before this first tillage takes place. Any advantage for surface mulch of residue in fallow must be made from May to August. Naturally, the volume of initial residues and the climatic pattern during this 4-month period will govern the amount of extra water which may be saved by surface mulch.

During years when large quantities of initial stubble are available, there may still be adequate supplies of surface residues at the end of the fallow season using a disk and rod weeder if the number of fallow operations needed to control weeds are not excessive. In other years, where the quality and quantities of initial residues are fair to poor, then, only sweeps, sprays, and rod weeder operations should be used.

The following table indicates the variability in initial residues, rainfall and moisture storage that can be expected for silt loam soils involved at Peetz and Akron, Colorado.

Soil moisture storage on summer fallow, winter wheat residues, Colo. 1956-58

Location, year	Tillage		Estimated residue per acre		Rainfall		Stored moisture
			Initial	Final	Sept.-Aug.	June-Aug.	
	Type	No.	*Pounds*	*Pounds*	*Inches*	*Inches*	*Inches*
Peetz, Colo. 1956	Plow-disk	(6)	2,000	0	12.0	8.5	2.0
	Disk	(6)	2,000	400	12.0	8.5	2.2
	Sweep	(5)	2,000	1,200	12.0	8.5	2.6
Peetz, Colo. 1957	Plow-disk	(4)	2,400	0	21.0	14.7	8.5
	Disk	(6)	2,400	300	21.0	14.7	9.6
	Sweep	(5)	2,400	1,500	21.0	14.7	10.4
Peetz, Colo. 1958	Plow-disk	(4)	5,300	500	19.0	11.7	5.8
	Disk	(4)	5,100	2,000	19.0	11.7	8.0
	*Sweep	(3)	4,800	3,500	19.0	11.7	*6.0
Akron, Colo. 1958	Disk	(4)	4,000	200	14.5	9.6	5.2
	Sweep	(4)	4,000	1,000	14.5	9.6	6.2

*Failure to work down excessively large clodes in August; stubble still upright at seeding time.

New Jersey

MINIMUM TILLAGE SHOWS PROMISE FOR VEGETABLES

G. D. Brill, New Brunswick. --In the first two years of a tillage study on Collington sandy loam, yields of cabbage and tomatoes with minimum tillage were equal to those with conventional tillage but were reduced by mulch tillage.

The conventional plots were disked three times after plowing. Minimum tilled plots were plowed and cabbage was wheel-track planted with no other seedbed preparation. Tomato rows were firmed after plowing with a 3-foot cultipacker before planting. On the mulch plots, the plants were set in 18-inch furrows 3 inches deep opened with a lister. A 6-inch sweep attached to the lister loosened the soil to a depth of 8 inches beneath the row. A mechanical plant setter was used on all treatments and 500 pounds of 5-10-10 fertilizer was sidedressed at planting. Additional phosphorus and potash had been added the previous fall. All plots were sweep cultivated and additional nitrogen was sidedressed.

Tillage effects on cabbage and tomato yields,
New Brunswick, N. J.

Treatment	Yield per acre	
	Cabbage	Tomatoes
	Tons	*Tons*
Conventional..............	19.2	33.8
Minimum..................	19.1	35.0
Mulch....................	14.3	33.0

Moisture tension was significantly lower under the minimum and mulch treatments as compared to the conventional. Tissue tests indicated a nitrogen deficiency in cabbage on the mulch plots. This was not found in tomatoes. Planting and cultivating were more difficult on the mulch plots and more resetting of plants was necessary. Minor changes in equipment design would probably take care of this.

Minimum tillage has the advantage of eliminating one or more tillage operations resulting in lower production cost. Since the soil surface early in the season is generally rougher and the plowed layer less compact, infiltration rates are higher and greater temporary water storage is provided compared to conventional tillage.

More data are needed under a wider range of climatic conditions before definite recommendations on minimum tillage for vegetables can be made. Mulch tillage also needs further study.

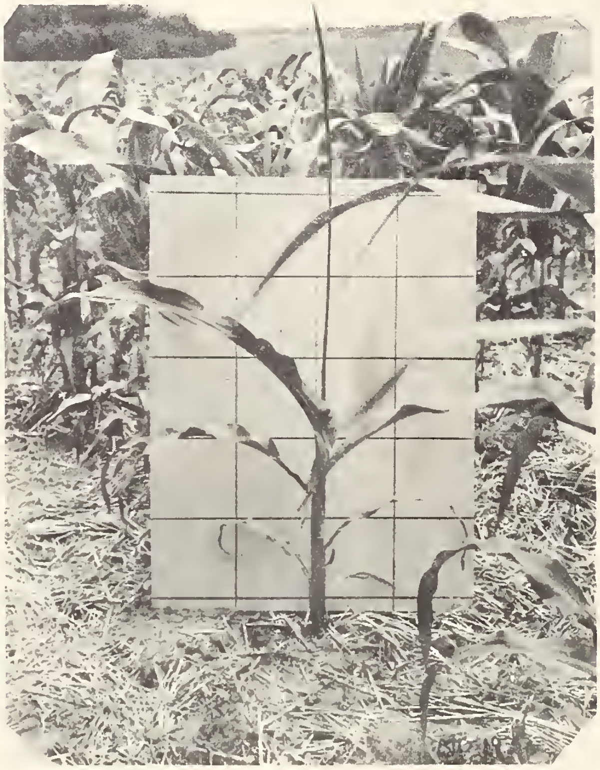
Maryland

MULCH INTENSIFIES 2,4-D INJURY

Robert V. D. Broach and C. S. Slater, Beltsville. --An overdose of 2,4-D caused more injury to corn on straw-mulched plots than it did on comparable nonmulched plots at Beltsville in 1958.

An amine formulation of 2,4-D was applied with an ordinary farm sprayer at a rate somewhat in excess of the calculated 3 pounds per acre. In a period of cool weather that followed, the 2,4-D persisted for a week to 10 days as indicated by odor and evidently was retained to the greater degree where the plots had been mulched. The mulch was weathered oat-straw at 2 tons per acre.

The injury associated with 2,4-D appeared in the form of bayonet leaf as shown in the illustration. Counts of such deformed plants made 6 weeks after the spray had been applied showed only 1.6 percent of the plants affected on nonmulched plots and 6.4 percent affected on the straw-mulched plots. Data are given in the table.



Bayonet leaf of corn resulting from 2,4-D injury, Beltsville, Md. 1958

Corn plants showing bayonet leaf injury from 2,4-D on mulched and nonmulched plots, Beltsville, Md. 1958

	Mulched	Nonmulched
	Percent	*Percent*
	7.0	2.0
	5.5	1.0
	8.0	0.5
	7.5	1.5
	4.0	4.0
	4.0	0.5
	7.0	2.0
	8.0	1.0
Mean Injury	6.4	1.6

Louisiana

DEEP TILLAGE DID NOT INCREASE YIELDS

Irwin L. Saveson and Zane F. Lund, Baton Rouge.--Seven deep tillage tests on sugar cane and two on cotton in 1958 showed no significant increase in yields due to deep tillage. The rainfall in Louisiana during the crop season of 1958, however, was slightly above normal with a very even distribution over the crop-growing period, resulting in above average soil moisture condition. This substantiates previous results showing that on soils responding to deep tillage, the beneficial effects are greatest in years of uneven distribution of rainfall.

Iowa

SOIL TEMPERATURE A FACTOR IN MULCH TILLAGE

W. E. Larson, Ames.--In northern States, during the early growing season, soil temperature in the root zone is below optimum for growth of corn and a reduction in soil temperature due to a surface mulch will reduce growth. In contrast, in southern States, soil temperatures frequently fluctuate above and below the optimum temperature for corn growth and data show that in this area corn growth is not adversely affected by a surface mulch.

In 1957, a mulch tillage experiment was conducted in a uniform manner at four locations in the Eastern States and soil temperatures and plant growth were accurately measured throughout the season. Early growth of corn was markedly reduced by mulches in Iowa and Minnesota but was not influenced in South Carolina. The range of soil temperatures at the 4-inch depth measured during the first 2 months after planting, together with a soil temperature-growth curve, is given in figure 1. Calculations show that in Iowa soil temperature at all depths did not exceed the optimum temperature for growth; whereas, in South Carolina, soil above about 3 inches in depth frequently exceeded the optimum temperature for growth. Thus, in Iowa, any reduction in soil temperature due to a mulch would be expected to reduce growth. Temperature in the root zone fluctuated above and below the optimum in South Carolina and, hence, reductions in soil temperature would probably not have a great influence. The growth data in figure 2 confirm this belief.

Final grain yields were not materially influenced by the mulch probably because drought and other factors were limiting growth later in the season. However, the slow early growth would undoubtedly reduce grain yields some seasons. Also, slow early growth makes weed control more difficult and stands are often reduced because of poorer germination and greater disease.

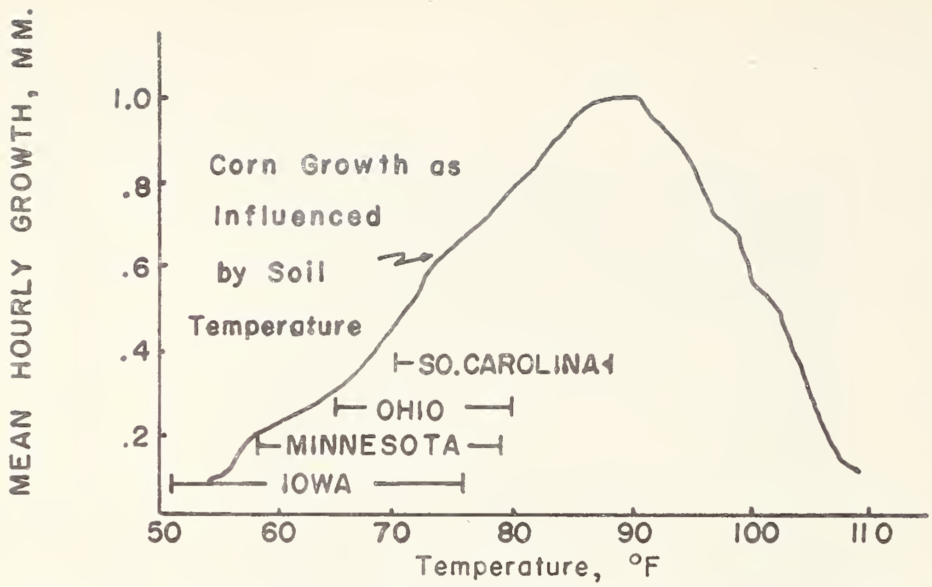


Figure 1. Growth of Corn Seedlings at Different Temperatures Together with The Range of Soil Temperatures at the 4-Inches Depth with no Mulch Cover During the 2 Months Following Planting at the Four Locations.

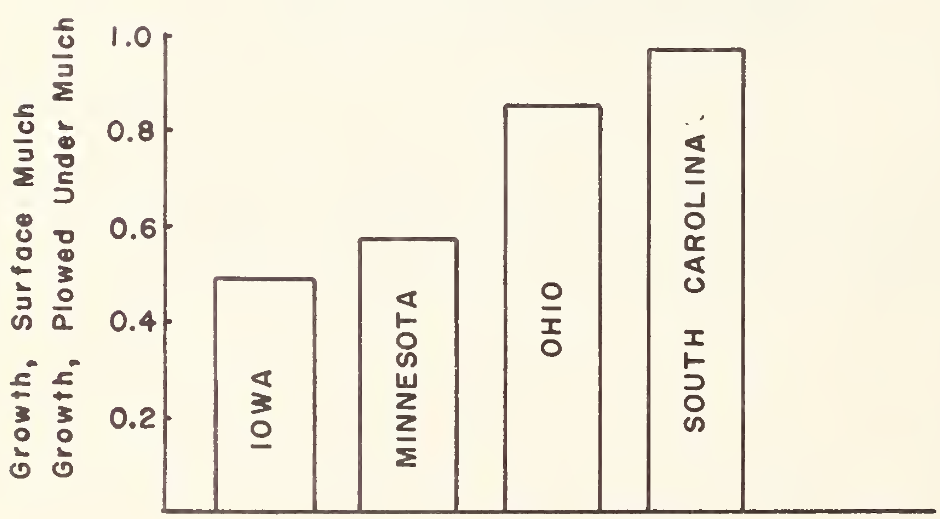


Figure 2. The Ratios of Corn Growth Early in the Season from Treatments having Straw on the Surface to those having Straw Plowed Under.

Nebraska

INFLUENCE OF STUBBLE MULCHING ON CARBON AND NITROGEN OF SOIL

Fred A. Norstadt and T. M. McCalla, Lincoln.--Organic matter and total nitrogen are slightly higher after 19 years of stubble mulching than on plowing. Determinations were made of readily oxidizable organic matter, carbon, and nitrogen on plots at Lincoln that have been either plowed or subtilled over a period of years. Nine of the replications sampled in this study have been established for 19 years and are apparently the oldest continually subtilled and plowed plots in the world. The other 4 replications were 14 years old. Two rotations were involved--one consisting of corn, oats, and wheat; and the other sweetclover, oats, wheat, and corn. The plots were located on a soil classified as Sharpsburg silty clay loam which is typical of many eastern Nebraska soils in fertility and texture. The results are shown in tables 1 and 2.

Readily oxidizable organic matter, carbon, and nitrogen are higher in the surface inch of the subtilled plots than in the plowed ones. Although the amounts in the 1 to 6 inch and 6 to 12 inch layers were not significantly higher in the subtilled plots, the trends indicate that the values for lower layers were not less than in the plowed plots.

TABLE 1.--Effect of stubble mulching and plowing on carbon and nitrogen in the soil, Lincoln, Neb.

Tillage	Sampling depth in inches			
	0 to 1	1 to 6	6 to 12	0 to 12
	Organic matter - Milliequivalents per gram[1]			
Plowed	4.92	4.96	3.88	4.42
Subtilled	5.39	5.04	4.06	4.58
Mean	5.15	5.00	3.97	4.50
	Carbon - Percent[1]			
Plowed	1.84	1.89	1.31	1.60
Subtilled	1.99	1.90	1.37	1.64
Mean	1.92	1.90	1.34	1.62
	Nitrogen - Percent[1]			
Plowed	0.163	0.164	0.128	0.146
Subtilled	0.171	0.166	0.135	0.151
Mean	0.167	0.165	0.131	0.148
	Carbon-Nitrogen ratio[1]			
Plowed	11.3	11.5	10.2	10.8
Subtilled	11.6	11.4	10.2	10.8
Mean	11.5	11.4	10.2	10.8

[1] Each figure represents the mean of duplicate determinations on each of 13 plots.

TABLE 2.--Correlation between the milliequivalents of readily oxidizable organic matter per gram of soil and the percent of carbon in plowed and subtilled soil, Lincoln, Neb.

Tillage	Sampling depth	Correlation coefficient
	In.	*(r)*
Plowed......................	0-1	0.920**
	1-6	0.945**
	6-12	0.982**
Subtilled..................	0-1	0.821**
	1-6	0.918**
	6-12	0.877**

**Correlation coefficient (r) significant at the 1 percent level.

The calculated values for the carbon-nitrogen ratios were not different for the subtilled and plowed plots, indicating that no substantial change had taken place in the nature of the soil organic matter insofar as this ratio may indicate a change. Correlation coefficients were calculated relating the milliequivalents of readily oxidizable organic matter and carbon, and were found to be highly significant, showing the readily oxidizable organic matter and carbon contents were closely associated. A tendency for a lower correlation in the subtilled plots than in the plowed plots at comparable depths was apparent. This may have been because of the nature of the partially decomposed residues accumulated in subtilled plots. The higher carbon-nitrogen ratio in the top inch may be because of the organic matter having undergone slightly less decay on the subtilled than plowed plots. Therefore, less carbon was lost.

Nebraska

CHEATGRASS NOT CONTROLLED BY WHEAT PLANTING MANAGEMENT

C. E. Domingo, Mitchell. --In an initial experiment in the study of downy brome (cheatgrass) control, different dates of wheat seeding were combined with different September dates of rod weedings preceding the planting. Downy brome seed had been broadcast over this summer-fallowed site, near Alliance, on September 10, 1957, just preceding the first of the differential treatments. No treatment gave a satisfactory control of downy brome.

Where wheat was planted, there was no significant difference in population or plant yield of downy brome or wheat due to tillage or planting date treatments. Among treatments in which wheat was not planted, tillage increased downy brome population. Planting of wheat reduced downy brome population.

Results may have been different had the downy brome seed been broadcast three or four weeks earlier than in this initial experiment of the program, or had earlier dates been included in the combinations of treatments.

SOIL AND WATER MANAGEMENT--GENERAL

Georgia

FROST DAMAGES ROADBANKS

E. C. Richardson, Cartersville. --Temperatures of two degrees above zero and ice formation created heavy frost erosion from unprotected roadbanks with slopes greater than 2:1 in the Coosa Watershed of northwest Georgia several days during the period December 10, 1957 to February 22, 1958. Protection by mulch and/or vegetative cover either prevented frost erosion or trapped the moving soil before it reached the roadside ditches at the foot of the slopes.

During this period of low temperatures and immediately after, a careful study revealed that immediate frost damage was greatest on banks of 2:1 or steeper slope. On the upper one-third of some bare untreated banks of such steepness, a depth of 8 inches of soil was lost. Loosened material, as a result of thawing, rolled down the banks by gravity to the foot of the slope or was lodged and held by vegetation.

On slopes flatter than 2:1, ice formation appeared to be as great as that on steep slopes, but the soil loosened after thawing generally settled and remained in place.

Frost erosion during this period appeared to be greatest on slopes facing east, south, and west. Steep banks facing north did not erode as badly as the other exposures, due to the fact that the soil remained frozen over a longer period.

Mulches appeared to insulate the surface of the soil and to act as a holding agent for the loosened material. Little soil moved as a result of frost action where mulch was applied except on the steepest slopes.

Grass sods and kudzu with and without mulch completely stabilized the soil where stands were adequate.

Foilage of all the cool-season grasses, orchard, fescue, and brome, planted in the fall of 1956 was killed back to the base of the plant by the extremely cold weather. However, all of the plants appear to be alive. Seedlings of the same species planted in the fall of 1957, or that volunteered in stands of old plantings, came through with only tip injury.

Figure 1.--General view of bank which was treated in the fall of 1957. Soil is Decatur clay. Flatter slope in foreground, very little damage resulted from frost action. Heavy erosion occurred on bare steep slopes in background as successive photographs show, Cartersville, Ga.

Figure 2.--Unmulched English ivy planting. Note large deposit of material at foot of slope. No frost erosion occurred from vegetated plants in background, Cartersville, Ga.

Figure 3.--Foreground shows honeysuckle which was mulched at planting time. No erosion occurred. Partially sodded unmulched grasses plot beyond honeysuckle reduced erosion. Well sodded plots in background were completely stabilized, Cartersville, Ga.

Illinois

CROP GEOMETRY IMPROVES CROP YIELDS

D. B. Peters, Urbana.--Corn yields were increased by planting techniques which resulted in orientation of leaves in a field trial conducted at the Agronomy South Farm, Urbana. Leaf orientation, by shading a greater percentage of the soil, reduced evaporation from the soil surface thereby increasing the amount of water which was available for transpiration processes.

Corn seedlings which emerge from the germ side of the corn kernel nearly always have their leaves extending at right angles to the flat axis of the corn kernel itself. By placement of kernels, with the flat axis parallel to the row, each stalk grew with the leaves perpendicular to the direction of row. With such a system, self-shading was reduced to a minimum and considerable more leaf area exposed to sunlight. Under such a system, approximately a 10 bushel/acre increase in corn yield was obtained over the normal planting system where self-shading was visibly evident.

Further research is planned to devise systems of planting which will make maximum use of sunlight and other external factors.

Missouri

WATER INTAKE RATES OF SHELBY-GRUNDY SOILS STUDIED

V. C. Jamison and J. F. Thornton, Bethany.--Twelve storms from the Bethany SCS Experiment Station records were selected as suitable for hydrograph analyses for soil intake rates by the method of Sharp and Holtan. Intake rates from the analyses show that moisture absorption by Shelby and Grundy soils depends more on antecedent moisture content than soil cover or management practice. Intake rates varied from over 2 inches/hour on dry soil to less than .01 inch/hour on very wet soil. As the soil gets wet, intake decreases rapidly and runoff must occur. Good management will save water from storms occurring on moist to dry soils. Water flowing from protected soil will carry little sediment, while runoff from poorly managed Shelby-Grundy soils may be loaded with topsoil.

Montana

SALT ACCUMULATES IN THE ROOT ZONE WITH SUBIRRIGATION

Ralph E. Campbell, Huntley.--An established stand of alfalfa can obtain a large amount of moisture needed for growth from considerable soil depth. This has been successfully demonstrated in a field trial at Huntley, Montana. However, experimental evidence showed that when an alfalfa crop was grown without irrigation on land with a water table six to nine feet below the surface, salts accumulated to a dangerous level in the two to three feet soil depth over a four-year period.

Prevention of salt accumulation was accomplished with three or six irrigations per year. One irrigation per year was not sufficient to prevent salt accumulation. The table shows the conductivity of the saturation extract at the start of the experiment and, again, in August 1956 at the end of 4 years' irrigation. A soil with a conductivity of 4 millimhos per cm. or greater is considered a saline soil.

Conductivity measurements in a soil with water table at six to nine feet depth as affected by irrigation treatments on alfalfa, Huntley, Mont.

Soil depth	Initial conductivity	Conductivity			
		Number of irrigations per year			
		6	3	1	0
Feet	*ECX10³*	*ECX10³*	*ECX10³*	*ECX10³*	*ECX10³*
0-1.........	0.6	1.9	1.6	1.7	1.2
1-2.........	0.7	1.2	1.4	1.4	1.8
2-3.........	1.0	1.1	1.6	4.0	4.0
3-4.........	1.4	1.6	3.2	6.3	6.3
4-5.........	1.4	1.5	3.7	6.0	7.4
5-6.........	1.5	1.5	3.1	4.9	6.6

SEDIMENTATION

Mississippi

CHANNEL DEGRADATION MEASURED BELOW RETENTION STRUCTURE

R. Woodburn, Oxford. --Detailed studies indicate degradation in a reach of sand bed channel below the powerline dam in Lafayette County, Mississippi, built in 1953. Channel ranges were installed in 1951 in anticipation of the construction of the dam. Little channel clearing was observed for a year or two following construction due to low rainfall and low flows through the drop inlet. Since that time, more nearly normal channel flow has taken place and considerable channel cleanout has been noted.

A resurvey of the channel was made in late 1958. The results of that survey are as follows:

Channel degradation in a 6,477 feet reach below powerline dam 1953-1958

Station	Volume of sand removed	Channel lowered
78 + 27 (Dam)...........	19,445 cu. yd.	6.7 ft.
25 + 50 (Highway 6)......	1,851 cu. yd.	
13 + 50 (End of ch. degradation)....		0.0 ft.
	21,296 cu. yd.	
	13.2 ac. ft.	
Orig. slope 13 + 50 to 78 + 27		0.00556
1958 slope 13 + 50 to 78 + 27		0.00445

Where this channel has lowered about 5 feet, some 400 feet downstream from the dam, a side gully has started and has made significant growth during the past 2 years.

Mississippi

SMALL RESERVOIR SEDIMENTATION STUDIED

R. Woodburn, Oxford.--The Powerline reservoir in Lafayette County has a drainage area of about 311 acres with about 52 acres of active gullies. The dam was constructed in 1953. The primary spillway is a typical drop inlet structure with a 42-inch pipe conduit under the dam.

A resurvey, made in 1958, shows the vertical distribution of sediment in the reservoir in relation to the elevation of the spillways.

Elevation	Volume to elevation shown		Sediment distribution	Reservoir volume occupied by sediment to elevation shown
	Original reservoir	Sediment		
Ft.	*Ac.-Ft.*	*Ac.-Ft.*	*Percent of total*	*Percent*
385	0.96	0.96	6	100
387	2.53	2.02	13	80
390	6.55	2.92	19	45
393	13.54	4.30	28	32
396.55 Spillway	30.54	9.20	61	26
400	59.62	13.57	90	23
402.55 Em. Spillway	90.02	14.47	95	16
405	126.28	15.17	100	12

Approximately 0.59 of a watershed surface inch of sediment was trapped in this reservoir during the 5 years; a rate of 0.12 surface inch per year. This reduced the capacity of the reservoir below emergency spillway elevation about 16 percent in 5 years, or a rate of 3 percent per year. The capacity below normal spillway elevation was reduced by 26 percent in 5 years, or at a rate of 5 percent per year.

HYDRAULICS

Colorado

TRAPEZOIDAL FLUMES SHOW PROMISE FOR MEASURING WATER

A. R. Robinson, Fort Collins.--The figure in the upper left-hand corner of page 42, Quarterly Progress Report No. 17, was printed upside down.

Minnesota

DRAINTILE JUNCTION DATA BEING ANALYZED AND MOVIE PREPARED

F. W. Blaisdell and P. W. Manson, Minneapolis.--Tests on draintile junctions were made using junction angles of 15°, 30°, 45°, 60°, 75°, 90°, 105°, 120°, 135°, 150°, and 165°; main lines 1, 2.12, 4, 7.11, and 16 times the area of the lateral; and flows from the lateral of about 0, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 percent of the flow in the main downstream from the lateral. Most of these laterals entered the main at the centerline of the main, but a number of the laterals also entered at the top or the bottom of the main. In all, 64 different junctions were tested. The joining edge was sharp in all cases. Junctions were tested using velocities of 2, 5, 10 and 15 feet per

second in the downstream main for successive tests. Some 2,217 test runs were made and junction energy losses determined for both the lateral and the main. Thus, some 4,434 sets of data are available for analysis.

The data were punched on cards for computations using an IBM 650 electronic digital computer. The computation consisted of fitting the sample data for each junction to second degree equations having 2 or 3 coefficients by least squares and also fitting all the data to second degree equations having 3 to 5 coefficients. Junction loss coefficients were computed from all data using both the sample and the general least squares equations and the theoretical equations. Residuals were also computed. Statistical tests of goodness of fit are now in process.

The general equations for the junction energy loss coefficients are:

For the main with center entry of lateral:

$$\zeta_u = 2.777\left[\frac{Q_b}{Q_d}\right] - \left[2.151 + 1.907\,\frac{A_d}{A_b}\cos\theta\right]\left[\frac{Q_b}{Q_d}\right]^2$$

For the lateral with the center entry to main:

$$\zeta_b = -0.7593 + 2.163\left[\frac{Q_b}{Q_d}\right] - \left[1.606 + 0.5552\,\frac{A_d}{A_b}\cos\theta - 0.8432\left(\frac{A_d}{A_b}\right)^2\right]\left[\frac{Q_b}{Q_d}\right]^2$$

For the main with the top or bottom entry of lateral:

$$\zeta_u - 1.106\,\frac{Q_b}{Q_d} + \left[0.7135 - 1.583\,\frac{A_d}{A_b}\cos\theta\right]\left[\frac{Q_b}{Q_d}\right]^2$$

For the lateral with the top or bottom entry to main:

$$\zeta_b = -0.7951 - 0.2129\left[\frac{Q_b}{Q_d}\right] + \left[5.145 - 3.970\,\frac{A_d}{A_b}\cos\theta + 1.228\left(\frac{A_d}{A_b}\right)^2\right]\left[\frac{Q_b}{Q_d}\right]^2$$

The theoretical equations are:
For the main:

$$\zeta_u = 2\left[\frac{Q_b}{Q_d}\right] - \left[1 + 2\,\frac{A_d}{A_b}\cos\theta\right]\left[\frac{Q_b}{Q_d}\right]^2$$

For the lateral:

$$\zeta_b = -1 + 4\left[\frac{Q_b}{Q_d}\right] - \left[2 + 2\,\frac{A_d}{A_b}\cos\theta - \left(\frac{A_d}{A_b}\right)^2\right]\left[\frac{Q_b}{Q_d}\right]^2$$

Where ζ_u and ζ_b are the junction energy loss coefficients for the main and the lateral in the equation

$$h_l = \zeta\,\frac{V_d^2}{2g}$$

h_l is the junction energy loss of head, V_d is the velocity in the main downstream from the junction, g is the acceleration due to gravity, Q_d and Q_b are the discharges, and A_d and A_b are the areas of the main and the lateral, and θ is the angle between the lateral and the upstream main.

These equations are tentative and subject to change pending completion of the analyses.

A sound, color movie report of the draintile junction studies is being prepared. Most of the scenes have been photographed, but editing has not yet commenced. This movie will contain some field scenes, show the laboratory experimental apparatus, and show the joining of the lateral and upstream main flows at the junction for various proportions of flow from the lateral, for various sizes of lateral discharging the same flow, for various sizes of the main with each lateral discharging the same flow, for selected entry angles, and for laterals entering the main at the top and at the centerline.

The movie will show visually what can be computed through the use of the junction energy loss equations. The junction energy losses for different angles of entry are so nearly the same that they are usually unimportant in agricultural draintile systems. This means that the lateral can join the main at the most convenient angle without significantly affecting the loss at the junction.

Mississippi

PRELIMINARY STUDIES OF STANDING WAVE FLOW OVER SAND BEDS

B. Colby, Oxford. --A great deal of interest has been shown in standing wave flow over sand beds. It is, however, very difficult to secure field data on depths and velocities of flow in the troughs and crests of standing waves. At Oxford, emphasis has been placed on securing additional data. Hydraulic parameters computed from average values of depth, area, and velocity do not sufficiently characterize the flow, since standing wave flow rarely covers the entire width of a field stream. It usually extends across not more than one-half to two-thirds of the stream width.

In the following tables of preliminary data, the Froude flow criterion varies widely depending upon the location of the depth measurement.

Characteristics of the stream cross sections and reaches, Oxford, Miss.

Date	Flow	Depth	Mean velocity	Froude number	Slope	Shear velocity	Manning's "n"
	cfs.	*ft.*	*ft./sec.*	$F = v / \sqrt{gd}$		*ft./sec.*	
Apr. 4, 1957	34	0.31	3.16	1.00	0.0036	0.19	0.013
May 22, 1957	81	.49	3.99	1.00	.0058	.29	.018
May 1, 1958	171	.86	4.96	.94	.0024	.26	.013

Observations along a line parallel to the direction of flow, Oxford, Miss.

Date	Average wavelength	Observations	Average of depths	Average of velocities	Froude number
	ft.		*ft.*	*ft./sec.*	$F = v / \sqrt{gd}$
Apr. 4, 1957	2.6	At troughs	0.42	4.38	1.19
		At crests	.52	3.22	.79
		Average	.47	3.80	.99
May 22, 1957	3.2	At troughs	.53	5.10	1.23
		At crests	.70	3.55	.75
		Average	.62	4.32	.99
May 1, 1958	11±	At troughs	1.23	7.04	1.12
		At crests	1.52	6.09	.87
		Average	1.38	6.56	.995

PAPERS AND PUBLICATIONS

Some of the recently published papers and publications written solely or jointly by staff members of the Soil and Water Conservation Research Division are listed below.

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